3.9 VEGETATION AND TIMBER RESOURCES

The effects of the proposed HCP, SYP, and land acquisition on vegetation, including endangered, threatened, and rare plants, and timber resources are discussed in this section. Over time, the HCP, SYP, and change of ownership would alter the vegetation patterns across the landscape and change where, how, and to what extent timber would be grown and harvested. This section describes the vegetation and timber resources and the effects of these changes on them.

Information used to analyze the private lands in the redwood ecosystem of the Coast Range is based on PALCO's GIS database, which was expanded to include Elk River Timber Company lands being considered for acquisition. This database was derived from delineation of vegetation based on aerial photographs taken in 1986, updated to reflect recent timber harvesting and vegetation growth. To reflect growth, PALCO applied a modeling program (Forest Resource Inventory, Growth, and Harvest Tracking System [FREIGHTS]) to simulate how the vegetation has grown in the past decade. Because the SYP is required to match the CDFG WHR habitat classification scheme a crosswalk between the PALCO and WHR habitat types is provided in Appendix Table L-1. General vegetation types by alternative are presented in Table 3.9.1 for the Project Area (i.e., PALCO and Elk River Timber Company lands, and various Reserves). In addition, Table 3.9-2 presents habitat types in the marbled murrelet conservation areas (MMCAs) that are components of Alternatives 2 and 2a. Table 3.9-3 shows late seral habitat (LSH) by watershed analysis data (WAA). Figure 3.9-1 shows the vegetation on PALCO lands. Figure 3.9-2 shows old-growth and residual old-growth.

3.9.1 Affected Environment

3.9.1.1 Vegetation

PALCO owns approximately 209,834 acres in southern Humboldt County, California (Figure 1.2-1). The ownership is divided into five watersheds as defined by Subchapter 7 of the California Code of Regulations. None of the watersheds are sensitive as defined by the California Department of Forestry.

These lands are characterized by mixed stands of redwood and Douglas-fir forest, nonproductive forest lands, and non-forested areas. The distribution of these stands can be traced to the climatic history of the area and logging activity. Soil type and amount of rainfall influence the type and amount of vegetation that grows in the area. Well-drained soils and an abundance of rain and fog drip throughout most of these lands, resulting in a highly productive forest.

The Elk River Timber Company owns approximately 9,468 acres which are proposed for acquisition. They are intermingled with PALCO lands in the Headwaters area (Figure 1.2-1). They are similar in character to the PALCO lands. The vegetation ranges from recent clearcuts to late seral forest.

Much of the forest in the Project Area has been altered by silvicultural practices which tend to reduce diversity. Managed stands generally support fewer species in both the

Table 3.9-1. Current (Year 0) and Projected Acres of Various Habitat Types on PALCO and Elk River Timber Company Lands and in the Reserves Under the Alternatives [1/]

	PALCO Ownership			Elk River Timber Co. Ownership			Proposed Headwaters or 63,000-acre Reserve			Total		
Habitat Type	**Year 0**	**Year 10**	**Year 50**	**Year 0**	**Year 10**	**Year 50**	**Year 0**	**Year 10**	**Year 50**	**Year 0**	**Year 10**	**Year 50**
ALTERNATIVE 1												
LSH	62,150	45,252	38,809	6,325	4,950	2,340	0	0	0	68,474	50,202	41,149
Uncut Old Growth	9,314	7,128	7,128	0	0	0	0	0	0	9,314	7,128	7,128
Douglas-fir	4,174	1,988	1,988	0	0	0	0	0	0	4,174	1,988	1,988
Redwood	5,140	5,140	5,140	0	0	0	0	0	0	5,140	5,140	5,140
Residual Old Growth	16,911	9,018	8,758	0	0	0	0	0	0	16,911	9,018	8,758
Douglas-fir	4,433	1,672	1,672	0	0	0	0	0	0	4,433	1,672	1,672
Redwood	12,478	7,346	7,086	0	0	0	0	0	0	12,478	7,346	7,086
Late Seral	35,925	29,106	22,923	6,325	4,950	2,340	0	0	0	42,249	34,056	25,263
Mid-seral	80,847	77,774	92,399	2,140	1,590	3,900	0	0	0	82,987	79,364	96,299
Young Forest	43,682	54,566	48,568	743	742	2,541	0	0	0	44,425	55,308	51,109
Forest Open	10,984	20,952	19,348	0	1,923	423	0	0	0	10,984	22,875	19,771
Hardwood	1,563	1,083	504	0	0	0	0	0	0	1,563	1,083	504
Prairie	5,687	5,202	5,202	0	0	0	0	0	0	5,687	5,202	5,202
Other Non-timber	4,922	4,910	4,910	260	260	260	0	0	0	5,182	5,170	5,170
Total	209,834	209,739	209,740	9,468	9,465	9,464	0	0	0	219,302	219,204	219,204
ALTERNATIVE 2												
LSH	63,170	38,479	23,576	0	0	0	5,304	5,329	5,868	68,474	43,808	29,444
Uncut Old Growth	6,197	3,864	2,964	0	0	0	3,117	3,117	3,117	9,314	6,981	6,081
Douglas-fir	4,174	2,622	1,722	0	0	0	0	0	0	4,174	2,622	1,722
Redwood	2,023	1,242	1,242	0	0	0	3,117	3,117	3,117	5,140	4,359	4,359
Residual Old Growth	16,245	5,085	4,076	0	0	0	666	666	666	16,911	5,751	4,742
Douglas-fir	4,433	867	867	0	0	0	0	0	0	4,433	867	867
Redwood	11,812	4,218	3,209	0	0	0	666	666	666	12,478	4,884	3,875
Late Seral	40,729	29,530	16,536	0	0	0	1,520	1,546	2,085	42,249	31,076	18,621
Mid-seral	82,362	78,701	97,816	0	0	0	625	598	1,496	82,987	79,299	99,312
Young Forest	43,021	54,062	58,066	0	0	0	1,404	1,437	0	44,425	55,499	58,066
Forest Open	10,950	30,615	23,179	0	0	0	34	0	0	10,984	30,615	23,179
Hardwood	1,563	978	198	0	0	0	0	0	0	1,563	978	198
Prairie	5,687	3,832	3,832	0	0	0	0	3	3	5,687	3,835	3,835
Other Non-timber	5,047	5,038	5,038	0	0	0	135	135	135	5,182	5,173	5,173
Total	211,800	211,705	211,705	0	0	0	7,502	7,502	7,502	219,302	219,207	219,207
ALTERNATIVE 2a												
LSH	58,351	34,787	22,805	6,325	4,950	2,340	3,798	3,798	4,320	68,474	43,535	29,465
Uncut Old Growth	6,197	3,864	2,964	0	0	0	3,117	3,117	3,117	9,314	6,981	6,081
Douglas-fir	4,174	2,622	1,722	0	0	0	0	0	0	4,174	2,622	1,722
Redwood	2,023	1,242	1,242	0	0	0	3,117	3,117	3,117	5,140	4,359	4,359
Residual Old Growth	16,245	5,085	4,076	0	0	0	666	666	666	16,911	5,751	4,742
Douglas-fir	4,433	867	867	0	0	0	0	0	0	4,433	867	867
Redwood	11,812	4,218	3,209	0	0	0	666	666	666	12,478	4,884	3,875
Late Seral	35,910	25,838	15,765	6,325	4,950	2,340	15	15	537	42,249	30,803	18,642
Mid-seral	80,290	77,188	94,913	2,140	1,590	3,900	556	557	1,417	82,987	79,335	100,230
Young Forest	42,333	53,338	53,630	743	742	2,541	1,349	1,382	0	44,425	55,462	56,171
Forest Open	10,950	28,968	23,712	0	1,923	423	34	0	0	10,984	30,891	24,135
Hardwood	1,563	978	198	0	0	0	0	0	0	1,563	978	198

	PALCO Ownership			Elk River Timber Co. Ownership			Proposed Headwaters or 63,000-acre Reserve			Total		
Habitat Type	**Year 0**	**Year 10**	**Year 50**	**Year 0**	**Year 10**	**Year 50**	**Year 0**	**Year 10**	**Year 50**	**Year 0**	**Year 10**	**Year 50**
Prairie	5,687	3,832	3,832	0	0	0	0	3	3	5,687	3,835	3,835
Other Non-timber	4,922	4,912	4,912	260	260	260	0	0	0	5,182	5,172	5,172
Total	204,096	204,003	204,002	9,468	9,465	9,464	5,738	5,740	5,740	219,302	219,208	219,206
ALTERNATIVE 3												
LSH	63,170	65,983	91,951	0	0	0	5,304	5,329	5,868	68,474	71,312	97,819
Uncut Old Growth	6,197	6,197	6,197	0	0	0	3,117	3,117	3,117	9,314	9,314	9,314
Douglas-fir	4,174	4,174	4,174	0	0	0	0	0	0	4,174	4,174	4,174
Redwood	2,023	2,023	2,023	0	0	0	3,117	3,117	3,117	5,140	5,140	5,140
Residual Old Growth	16,245	16,245	16,245	0	0	0	666	666	666	16,911	16,911	16,911
Douglas-fir	4,433	4,433	4,433	0	0	0	0	0	0	4,433	4,433	4,433
Redwood	11,812	11,812	11,812	0	0	0	666	666	666	12,478	12,478	12,478
Late Seral	40,729	43,541	69,509	0	0	0	1,520	1,546	2,085	42,249	45,087	71,594
Mid-seral	82,362	79,713	108,506	0	0	0	625	598	1,496	82,987	80,311	110,002
Young Forest	43,021	53,855	13	0	0	0	1,404	1,437	0	44,425	55,292	13
Forest Open	10,950	5	5	0	0	0	34	0	0	10,984	5	5
Hardwood	1,563	1,092	173	0	0	0	0	0	0	1,563	1,092	173
Prairie	5,687	6,029	6,029	0	0	0	0	3	3	5,687	6,032	6,032
Other Non-timber	5,047	5,032	5,032	0	0	0	135	135	135	5,182	5,167	5,167
Total	211,800	211,709	211,709	0	0	0	7,502	7,502	7,502	219,302	219,211	219,211
ALTERNATIVE 4												
LSH	44,714	28,907	21,704	2,021	1,306	643	21,743	23,332	32,689	68,478	53,545	55,036
Uncut Old Growth	4,445	2,396	1,685	0	0	0	4,869	4,869	4,869	9,314	7,265	6,554
Douglas-fir	3,957	2,388	1,678	0	0	0	217	217	217	4,174	2,605	1,895
Redwood	488	8	7	0	0	0	4,652	4,652	4,652	5,140	4,660	4,659
Residual Old Growth	10,707	2,878	1,006	0	0	0	6,208	6,208	6,208	16,915	9,086	7,214
Douglas-fir	4,320	1,886	793	0	0	0	113	113	113	4,433	1,999	906
Redwood	6,387	992	213	0	0	0	6,095	6,095	6,095	12,482	7,087	6,308
Late Seral	29,562	23,633	19,013	2,021	1,306	643	10,666	12,255	21,612	42,249	37,194	41,268
Mid-seral	65,483	62,617	70,340	1,990	1,479	2,481	15,514	14,691	29,661	82,987	78,787	102,482
Young Forest	21,380	29,292	38,027	645	645	1,275	22,400	24,337	0	44,425	54,274	39,302
Forest Open	8,283	21,382	12,884	0	1,226	256	2,701	0	0	10,984	22,608	13,140
Hardwood	1,450	960	202	0	0	0	113	13	23	1,563	973	225
Prairie	5,450	3,525	3,525	0	0	0	237	313	313	5,687	3,838	3,838
Other Non-timber	4,084	4,068	4,068	136	136	136	967	989	989	5,187	5,193	5,193
Total	150,844	150,751	150,750	4,792	4,792	4,791	63,675	63,675	63,675	219,311	219,218	219,216

1/ See Section 3.9 and Glossary for definitions of habitat types

Table 3.9-2. Habitat Types for 12 Marbled Murrelet Conservation Areas on PALCO lands for Alternatives 2 and 2a (acres)[1/]

Habitat Type	1[2/] Lower North Fork Elk	2 Bell Lawrence	3 Booth's Run	4 Elk Head Residual	5 Road 7 & 9 North	6 Right Road 9	7 Shaw Gift	8 Cooper Mill	9 Allen Creek & Extension	10 Road 3	11 Owl Creek	12 Grizzly Creek West/Center	Total
Uncut Old-growth Redwood		339			21	78	255		393		318	118	**1,522**
Uncut Old-growth Douglas-fir			158				31				13		**202**
Residual Old-growth Redwood	237	107	216	65	239	112	54	397	595	374	247	530	**3,174**
Residual Old-growth Douglas-fir			8								6		**14**
Late Seral	159	0	0	0	14			16	150	38	20	64	**462**
Mid-successional	46	23	78		98		32	136	445	111	18	265	**1,251**
Young Forest	8	156	199	286	100	69	103	155	37	0	211	14	**1,339**
Open Forest	1	6	126		0	59	27				70		**288**
Hardwood													**0**
Open, Non-timber					20				109	40		2	**171**
Grassland/Prairie		1									22		**23**
Total	**451**	**633**	**784**	**352**	**492**	**318**	**503**	**704**	**1,729**	**564**	**925**	**993**	**8,448**
Total without Grizzly Creek West/Center													**7,453**
Total without Owl Creek													**7,521**

1/ Eleven of these groves are protected in the HCP. Either the Owl or Grizzly Creek Grove would be cut.

2/ Numbers above correspond to those identifying the MMCAs in Figure 2.5-4.

Source: Foster Wheeler Environmental Corporation, 1998

Table 3.9-3. Current (Year 0) and Projected Acreage and Percentage of LSH in the Project Area by WAA [1/,2/]

		Alternative 1			Alternative2			Alternative 2b			Alternative 3			Alternative 4		
	Year 0	10	50	120	10	50	120	10	50	120	10	50	120	10	50	120
Humboldt Bay																
Acres in PA [3/]	23,645	15,498	12,466	13,802	14,205	9,868	13,043	13,740	9,890	11,147	22,037	30,368	36,395	18,077	20,257	25,090
%	51%	34%	27%	30%	31%	21%	28%	30%	21%	24%	48%	66%	79%	39%	44%	54%
Acres in PALCO [4/]	17,321	10,549	10,127	11,412	8,917	4,045	7,105	5,033	3,275	4,395	16,748	24,545	30,457	3,989	2,360	5,227
%	47%	29%	28%	31%	23%	10%	18%	16%	11%	14%	43%	63%	79%	24%	14%	32%
Yager Creek																
Acres in PA	7,500	6,004	7,239	9,127	4,985	5,125	15,302	5,010	5,125	15,316	7,213	12,070	18,355	7,732	12,692	16,968
%	22%	18%	21%	27%	15%	15%	45%	15%	15%	45%	21%	35%	54%	23%	37%	50%
Acres in PALCO	**ND** [5/]	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	0	20	102
%	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	0%	4%	19%
Van Duzen River																
Acres in PA	6,624	6,628	4,683	6,657	5,767	2,676	4,042	5,742	2,676	3,867	8,344	14,338	20,729	6,015	5,445	6,560
%	27%	27%	19%	27%	23%	11%	16%	23%	11%	16%	33%	58%	83%	24%	22%	26%
Acres in PALCO	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	5,187	4,590	5,683
%	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	22%	19%	24%
Eel River																
Acres in PA	30,440	18,250	12,330	16,304	14,966	8,018	14,071	15,157	8,018	12,042	29,043	39,959	56,652	16,971	12,863	21,858
%	40%	24%	16%	22%	20%	11%	19%	20%	11%	16%	38%	53%	75%	22%	17%	29%
Acres in PALCO	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	14,992	10,963	19,633
%	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	21%	15%	27%
Bear/Mattole River																
Acres in PA	7,395	3,489	4,114	4,208	3,856	3,740	3,825	3,856	3,740	5,005	7,011	7,268	10,171	4,784	3,740	3,756
%	21%	10%	12%	12%	11%	11%	11%	11%	11%	14%	20%	21%	29%	14%	11%	11%
Mad River																
Acres in PA	157	40	25	33	28	15	390	28	15	913	169	227	470	15	89	390
%	4%	1%	1%	1%	1%	0%	10%	1%	0%	23%	4%	6%	12%	0%	2%	10%

1/ Under Alternatives 2 and 4, PALCO's HCP/SYP proposes to maintain a minimum of 10 percent of their lands as LSH, which can consist of late seral, old growth or residual forest.

2/ Acreage and percentage of LSH on PALCO lands within each WAA is only displayed where it differs from the entire Project Area

3/ This acreage includes all lands in the Project Area within this WAA (Elk River Timber Company, PALCO, and the proposed reserves)

4/ This acreage only includes lands managed by PALCO within this WAA, outside of reserves, to facilitate comparison with footnote 1 above

5/ ND = No difference between amount of LSH in Project Area and on PALCO lands

Source: Foster Wheeler Environmental Corporation, 1998

tree and understory strata and have much less structural diversity (FEMAT, 1993). Short rotation, even-aged timber management removes complex old-growth stands and replaces them with more uniform stands with few large snags.

The Project Area is in the moist, highly productive coastal forests of northwest California. This ecosystem results from regional variations in climate, soil, and elevation, as well as local differences in these and other factors. This ecosystem contains a number of plant communities. These communities form the basis for the wildlife habitat discussed in Section 3.10. The major plant communities of the Project Area are discussed below. The crosswalks for these communities compared to those shown in Table 3.9-1 are displayed in Appendix L.

Redwood Stands

Redwood stands are distributed in an irregular strip along the coast of California from the extreme southwestern corner of Oregon extending about 450 miles south to Monterey County. The strip is 5 to 35 miles wide in a region of fog and high soil moisture content that ranges from sea level to 3,500 feet in elevation. Redwood is generally found in association with Douglas-fir, western hemlock, California bay, madrone, and tanoak with an understory of California huckleberry, various ferns, rhododendrons, western azaleas, and wood-sorrel. Prior to 1850 the redwood forest covered approximately 2,170,000 acres and is estimated to have contained more than 100 billion board feet of timber. In 1980 California still contained approximately 1.6 million acres of forested land with redwood trees (Green, 1985). Mature trees range from 200 to 240 feet tall and are often 10 to 15 feet in diameter. The largest trees may reach a height of 350 feet, 17 feet in diameter, and may be approximately 1,800 years old. Mature redwood is fire resistant, generally free of fungal disease, and not normally attractive to insects. Redwood stands support a variety of populations of birds, mammals, amphibians, and reptiles. Mature trees effectively block well over 90 percent of the light striking them, creating a heavily shaded growing environment for understory species. Annual rainfall during the wet season ranges from 35 to 100 inches per year while in the dry summer weather redwoods rely heavily on condensation from fog.

Redwoods currently grow throughout their natural range, but large areas that once supported redwood have been converted to urban and agricultural uses. Approximately eight percent of the remaining forest area is considered old-growth redwood, 65 percent is predominantly younger redwood stands, and 13 percent Douglas-fir and hardwoods with redwood as an associated tree. The remaining 14 percent consists of minor tree species and non-forest vegetation. More than 130 years of timber harvest and related activities have changed the forest composition by shifting the age class distribution from primarily old-growth to younger immature stands. The age of most stands of trees is less than 130 years old with a large percentage less than 50 years old. Young redwood stands have fewer associated tree species than old-growth stands. The remaining old-growth stands are widely separated, often by extensive areas of highly fragmented forest (Fox, 1996). Humboldt Redwoods State Park, approximately 17 miles south of the Headwaters Grove area, and Redwood National Park, approximately 30 miles to the north, are the closest areas to PALCO property with large old-growth redwood forests.

Generally, the most productive and largest redwood stands grow on the moist alluvial floodplains and terraces in association with other shade-tolerant tree and shrub species

Figure 3.9-1. Vegetation Map

11x17

Figure 3.9-1 back of 11x17 page

Figure 3.9-2. Location of Uncut and Residual Redwood & Douglas-Fir Old Growth in the Project Area

11x17

Figure 3.9-2 back of 11x17 page

such as western hemlock, Sitka spruce, grand fir, occasional western redcedar, tanoak, red alder, rhododendrons, azaleas, sword fern, deer fern, salmonberry, California huckleberry, red huckleberry, fireweed, oceanspray, poison oak, thimbleberry, casara, ceanothus, and oxalis (Mayer and Laudenslayer, 1988). Fires are infrequent and rarely occur more often than every 500 years. However, when a forest of this type does burn, the typical fire intensity is relatively low, and the fire only damages thin-barked or low growing species, leaving the taller, thick-barked species such as redwood and Douglas-fir as the dominant trees. Only shade tolerant species such as redwood, western hemlock, and western redcedar regenerate under these conditions.

Redwoods are vigorous sprouters, unlike other conifer associates. Sprouts eventually form the dominate canopy after disturbances such as timber harvest. Redwood also regenerates well by seed (Mayer and Laudenslayer, 1988). Inland redwood stands generally grow on steeper slopes and are a mixture of Douglas-fir, redwood, tanoak, and madrone. The stands become less vigorous at higher elevations and with increased distance from the ocean. Fires are more frequent and in some areas occur every 30 to 50 years. The fires are hotter and damage more trees. The residual stands are more open, hotter, and dryer. They provide a harsher regeneration environment. Shade-tolerant western hemlock and redcedar do not regenerate successfully in these conditions, and the resulting stands are dominated by Douglas-fir, tanoak, and madrone, with redwood as a minor species (Twight, 1993; Barbour and Billings, 1988).

Douglas-fir Stands

The Douglas-fir forest is a complex mosaic of stands resulting from geologic, topographic, and successional variations. Redwood usually represents some percentage of Douglas-fir stands. Typically, these stands include a lower understory of dense, sclerophyllous, broad-leaved evergreen trees (tanoak and madrone) which are often over 100 feet tall, with an irregular, higher overstory of taller conifer. Douglas-fir, the major species, can reach heights of nearly 300 feet and diameters of 15 feet with an average of five to seven feet (Marcot, 1979; Sawyer, 1980; Thornburgh, 1982; Franklin et al., 1981 in Mayer and Laudenslayer, 1988). A small number of pole and sapling trees occur throughout these stands. On wet sites, shrub layers are well-developed, often covering 100 percent of the area. Herbacious plants can cover up to 10 percent of the ground. The shrub and herbacious layers are poorly developed in dryer areas. The diversity of tree size typically increases with stand age, as does spacing (Franklin et al., 1981). Young stands are usually dense and uniform. As trees age, many die, creating gaps in the overstory, large snags, and down logs. These gaps in the overstory are quickly filled with tanoak and madrone. This process can take from 80 to over 250 years (McArdle, 1961; Lang, 1980; Franklin et al., 1981). This plant community occurs at moderate elevations in juxtaposition with other plant communities, including redwood, hardwood-conifer, and hardwood. Topography is usually rugged, deeply dissected terrain and steep slopes (Franklin and Dyrness, 1973, in Mayer and Laudenslayer, 1988).

As in the case with redwood, Douglas-fir trees currently grow throughout their natural range, but large areas that once supported Douglas-fir forests have been converted to urban and agricultural uses. Despite the fact that much of the remaining Douglas-fir forest has been converted to managed stands (FEMAT, 1993) there is still much older Douglas-fir stands remaining in the region.

On BLM lands in the Arcata Resource Area, there are approximately 20,000 acres of Douglas-fir-dominated stands with an average dbh of greater than 24 inches and a canopy closure of greater than 60 percent. All of this acreage is in reserved allocations under the Northwest Forest Plan. About 4,216 acres of these stands are scattered within various tributary watersheds of the Mattole River (Personal communications; S. Hawks, BLM Arcata Resource Area, September 9, 1998; Paul Roush, BLM Arcata Resource Area, September 9, 1998). On the Six Rivers National Forest, in Del Norte, Humboldt, and western Trinity counties, approximately 208,710 acres of late successional timber types containing Douglas-fir occur in late successional reserve management allocations or wilderness status under the Northwest Forest Plan (Personal communication, Jeff Mattison, Six Rivers National Forest, September 9, 1998). These stands consisted of multi-layered conditions and a total canopy closure greater than or equal to 70 percent from overstory trees greater than or equal to 21 inches dbh which comprises at least 40 percent of the total canopy closure. Additional acreage containing this vegetative series occurs in unmapped riparian reserves, occupied marbled murrelet stands, and 100-acre late successional reserves which would be unavailable for timber harvest.

Hardwood Conifer or Mixed Evergreen Forest

The hardwood-conifer plant community often occurs as a mosaic of small stands of conifers interspersed with small stands of broad-leaved hardwoods. These include tanoak, Oregon white oak, madrone, red alder, California black oak, golden chinquapin, and canyon live oak. Conifers include Douglas-fir, western red cedar, western hemlock, ponderosa pine, sugar pine, and knobcone pine (Kuchler, 1977; McDonald, 1980; Parker and Matyas, 1981, in Mayer and Laudenslayer, 1988). Between one-third and two-thirds of the trees are hardwoods (Anderson et al., 1976 in Mayer and Laudenslayer, 1988). This is a very diverse plant community that usually forms dense stands with little understory vegetation. Typically, conifers are up to 200 feet high, and hardwoods range from 30 to 100 feet (Cheatham and Haller, 1975, in Mayer and Laudenslayer, 1988). This community generally occurs on coarse, well-drained mesic soils in steep, mountainous terrain (Munz and Kech, 1970 in Mayer and Laudenslayer, 1988). Secondary succession is vigorous following fire or harvest. Hardwoods and shrubs regenerate together by sprouting from the root crowns. Hardwood trees normally mature in 60 to 90 years (Mayer and Laudenslayer, 1988).

Hardwood

The hardwood plant community, sometimes considered part of the mixed evergreen forest, is composed of hardwoods with poorly developed shrub and herbaceous layers. On better sites, trees or small clumps of trees are usually spaced 10 to 13 feet apart, while on poor sites they may average over 30 feet apart. Crowns seldom overlap. Trees range from only about 30 feet to nearly 100 feet tall with full crowns. Snags and down logs generally are sparse. Canyon live oak often forms pure stands on steep canyon slopes and rocky ridgetops. In other areas it forms a mixed stand with knobcone pine, gray pine, white oak, and coast live oak. At higher elevations, there is often a scattered overstory of pine. In the middle elevations, Douglas-fir, madrone, California laurel, and black oak often occur. Understory vegetation is mostly scattered shrubs (manzanita, mountain-mahogany, and poison oak) and a few forbs. This is a very stable plant community with many tree species that mature slowly, often living more than 300 years, and which sprout vigorously from the root crown if the aboveground portions are killed by fire or cut (Mayer and Laudenslayer, 1988).

Montane Riparian or Deciduous Riparian

Montane riparian plant communities generally occur as narrow dense groves of deciduous trees up to 100 feet tall. They are often diverse in both species and structure. Black cottonwood is a dominant tree, along with big-leaf maple in some areas. Dogwood and boxelder are also common. Montane riparian communities tend to maintain a mosaic of stages which vary as a result of periodic flooding. They are often damaged by debris, sedimentation, or the uprooting of entire plants which are redeposited further downstream. Riparian areas are associated with montane lakes, ponds, seeps, bogs, and meadows, as well as rivers, streams, and springs (Mayer and Laudenslayer, 1988).

Valley Foothill Riparian or Forested Wetland

Most trees in this plant community are deciduous, generally black cottonwood. Canopy height in mature riparian forest is nearly 100 feet, and canopy cover varies from 20 to 80 percent. Alder, boxelder, and Oregon ash are typical subcanopy trees. The understory is usually very dense, with wild grape, wild rose, California blackberry, blue elderberry, poison oak, buttonbrush, and willows. The herbaceous layer is sparse, except in openings. It generally includes sedges, rushes, grasses, miner's lettuce, Douglas sagewort, poison hemlock, and hoary nettle. Valley foothill riparian communities are often found on alluvial fans and slightly dissected terraces in floodplains (Mayer and Laudenslayer, 1988).

Perennial Grassland or Prairie

With the exception of coastal prairies under maritime influence, grasslands in the Project Area are either relic perennial grasslands now dominated by annual grasses, or grasslands created by timber harvest or fire followed by grazing. These annual grasslands are open areas whose structure depends largely on weather patterns and livestock grazing. Fall rains cause the germination of annual plant seeds. Plants grow slowly during the winter months. In spring, when temperatures rise, plant growth is rapid, especially in years with heavy spring rains. If grazing is light, large amounts of standing dead plant material persists through the summer. If spring grazing is heavy, summer annual forbs, such as tarweed and turkey mullein, are common. Introduced annual grasses include wild oats, soft chess, ripgut brome, red brome, wild barley, and foxtail fescue. Common forbs include broadleaf filaree, redstem filaree, turkey mullein, true clovers, bur clover, popcorn flower, and California poppy. Perennial grasses found in moist, lightly grazed relic prairie areas include purpose needlegrass and Idaho fescue. The nonnative annuals prevent the reestablishment of native perennials over large areas and now comprise the climax communities on natural perennial grasslands (Mayer and Laudenslayer, 1988). Areas that have been converted to grasslands through human activity can be distinguished from natural grasslands by their forest-type soil structures. The establishment of grasses on sites formerly supporting Douglas-fir may prevent succession back to the original forest cover (Mayer and Laudenslayer, 1988).

Wet Meadow

Wet meadows generally have a layer of herbaceous plants. Shrub and tree layers are usually absent or very sparse. Wet meadows have a great variety of plant species. Common genera include Agrostis, Carex, Danthonia, Juncus, Salix, and Scirpus. Important grass and grass-like species include thin grass, abruptbeak sedge, beaked sedge, Nebraska sedge, tufted hairgrass, spikerush, baltic rush, Nevada rush, iris-leaf rush, pullup muhly, and panicled bulrush. Important forbs include Anderson aster, Jeffrey

shootingstar, trailing Saint-Johnswort, hairy pepperwort, primrose monkeyflower, western cowbane, American bistort, cow's clover, and small white violet. Willow and bilberry are the only shrubs commonly found. Wet meadows occur where water is at or near the surface for most of the growing season. They usually occur as ecotones between fresh emergent wetlands and perennial grasslands. Where wet meadows merge with fresh emergent wetlands, slight differences in water depth control the species composition (Mayer and Laudenslayer, 1988).

Fresh Emergent Wetland

Fresh emergent wetlands are characterized by hydrophytes. Dominant vegetation is generally perennial monocots up to 6.5 feet tall. All emergent wetlands are frequently flooded and have vegetation which grows in anaerobic conditions. On the upper margins of fresh emergent wetlands, saturated or periodically flooded soils support several moist-soil plant species, including big-leaf sedge, baltic rush, and redroot nutgrass. On wetter sites, common cattail, tube bulrush, river bulrush, and arrowhead are dominant. These wetlands occur in association with both terrestrial and aquatic habitats, including riverine, lacustrine, and wet meadows. They can occur on any exposure and slope where there is a basin or depression with saturated soils. However, they are most common on level to gently rolling topography. They often follow contours and reflect the relative depth and duration of flooding. If the bottom of the wetland is very uneven, wetland vegetation may be patchy (Mayer and Laudenslayer, 1988).

Invasive and Noxious Weeds

Invasive and noxious weeds, such as Scotch broom (*Cytisus scoparius*), pampas grass (*Cortaderia jubata*), and tansy ragwort (*Senecio jacobaea*) are common in the region. These plants thrive in open areas with disturbed soil. They often spread into new areas along roads and logging skid roads. When the forest overstory is removed through timber harvest, these weeds may spread throughout the harvested area. These weed species may out-compete native plants, reducing native plant biodiversity in the understory. The risk of noxious weed infestation increases with the amount of road building and clearcutting.

Alternatives 2 and 2a would have the greatest risk of noxious weed infestation because they have the greatest amount of timber harvest. Alternative 3, which does not allow clearcutting, would not result in large openings and would have the least risk. However, the need for repeated entry associated with selective timber harvest could produce disturbed sites susceptible to invasive or noxious weed occupation. Alternative 4 would protect the 63,000-acre Reserve from increased risk of infestation. The remainder of the property would have a risk similar to that of Alternatives 2 and 2a. Alternative 1 would have slightly less risk that Alternatives 2 and 2a because of the lower timber harvest acreage.

3.9.1.2 Forest Health

A healthy forest can be defined as one which is free of widespread severe disease and maintains its productivity, nutrient capital, and biological diversity (Rapport, 1992). Various living and non-living agents such as fire, insects, disease, and animals alter the natural aging and death process of trees and associated plants. The following describe the most destructive agents present in the Project Area.

Windthrow is the most common natural cause of death of redwood trees. Strong winds produced by winter storms often cause the blow down of redwoods which have an extensive but shallow root system. When larger trees blow down, they typically knock down other trees, creating openings in the forest canopy. Normal forest

management operations can trigger the phenomenon of edge effect or exposing trees that have grown in wind-protected areas to full wind exposure. Blowdown can occur after road construction, along the edges of new clearcuts, and in partial cut areas. Old-growth trees are most susceptible to edge effect due to their large tree crowns, when winds exceed 50 miles per hour, the probability or risk of windthrow increases significantly. Second-growth stands of redwood are less susceptible to wind damage but windthrow will occur during periods of strong winds.

Redwood contains tannic acids in its wood, bark and foliage that act as toxic agents in resisting attacks by insects and fungal diseases. The heartwood is especially rich in tannin and is very resistant to decay for years after trees die. It is common for trees that died several hundred years ago to still be sound. Of the few diseases and insects that attack redwood, the most common are the heart rots of *Poria sequoiae* and *Poria albipeiiucida*, which probably enter the stem through fire scars, and the redwood bark beetle that infests weakened, felled, or fire-scorched trees. No diseases or insects cause death in mature redwood trees (Olsen et al., 1990; Cooper, 1965).

Douglas-fir is subject to serious damage from many agents, including hundreds of fungi. Few of these fungi cause serious damage. However, Rhizina undulata, Armillaria mellea, and Phellinus weirii (laminated root rot) are exceptions and cause significant damage. Trees die or their roots are so weakened that they blow over. More than 300 heart rot fungi attack Douglas-fir. The most damaging is Phellinus pini (red ring rot). Fomitopsis officinalis, F. cajanderi, and Phaeolus schweinitzii are also important. Several insects, including the Douglas-fir beetle, tussock moth, and western spruce budworm, are important damage agents. Crown fires are a major cause of mortality. Most natural Douglas-fir stands originated from stand replacement fires (Hermann and Lavender, 1990).

3.9.1.3 Old-growth Forest Ecology

The old-growth forests of western North America are unique among temperate forests of the world. One of the most outstanding features of these forests is the dominance of long lived, large conifers. In nearly all other mesic temperate regions, such as eastern Asia, eastern North America, and western Europe, deciduous or mixed deciduous/coniferous forests are the major natural forest formation. While there are individual trees which reach large size and live as long or longer, nowhere else are extensive stands of such large old trees found (Franklin and Dyrness, 1988).

Old-growth forests differ from younger stands in several respects. In most cases trees form a single crown canopy layer as they grow through their juvenile or early seral stages. They generally maintain this single canopy layer until competition, weather, insects or disease begin to cause mortality, resulting in "holes" in the canopy. Over time, seedlings become established and grow in these holes. This results in multiple canopy layers which include many large trees, some with broken tops and decaying wood, many large snags, and heavy accumulations of large logs on the ground. This process can begin in stands as young as 40 years in some areas and take well over 100 years in others (Green, 1985). Definitions of what constitutes old-growth varies. Some authors use tree diameter to define it as 50 percent or more of the conifer canopy in trees over 24 inches dbh, others use over 29 inches dbh, or over 41 inches dbh. Some use age and define it as a certain percent of trees being over 100 years or being mature (Green, 1985). This period in a forest's development, called the late seral or late-successional stage, is generally separated into two stages. The single-storied late-

successional stage contains large trees with some holes but multiple canopies have not yet developed. The multi-storied stage, true old-growth, develops over the next 100 to 200 years, as the multiple canopies with large snags and many large fallen trees become completely formed (NWFP, 1994). These multi-canopy old-growth forests provide additional stand structure creating important habitat for many plant and animal species.

Excellent examples of both redwood and Douglas-fir old-growth forests are found in the coastal forests of northern California. The climatic and soil conditions in this area produce dense stands of very large, long-lived trees. The greatest accumulation of biomass ever recorded is in an old-growth redwood stand in Humboldt Redwood State Park (Olsen et al., 1990). Individual trees in old-growth redwood stands may have 10 to 20 times the wood volume of an entire acre of trees in the deciduous forests of eastern North America (Burns and Honkala, 1990). This volume and the quality of the wood also make such redwood trees extremely valuable. The majority of the remaining old-growth redwood forest is in parks, approximately 90,000 acres (Green, 1985). In comparison, PALCO has approximately 9,314 acres of old growth (excluding residual stands) on its property, much of it in small, fragmented parcels. Approximately 5,140 acres of this is old-growth redwood. The remainder is Douglas-fir old-growth forest.

As in other old-growth forests, these remnant multi-canopy, old-growth stands provide important habitat for many plant and animal species not provided by younger forests. Lichens fix significant amounts of nitrogen that ultimately are available to the entire forest ecosystem through leaching, litter fall, and decomposition. These lichens need the high moisture levels and protection from drying winds that the dense redwood canopy provides. These conditions are not common in young stands, and consequently epiphytic nitrogen fixing is largely confined to old stands. Over the decades the nitrogen fixed by these lichens makes a major contribution to the productivity of the site (Franklin and Dyrness, 1988).

The multiple canopies of the old-growth forest provide habitat for a variety of insects. The insects are found in all areas of the canopy including the limbs, twigs, and foliage. A single stand may have more than 1,500 species. A few species spend their entire life cycle in the canopy while the majority of species start life on the forest floor and as adults migrate to the canopy. Invertebrate species commonly found in old-growth canopies include spiders, mites, butterflies, moths, bees, ants, flies, and other flying insects (Franklin et al., 1981). A discussion of wildlife habitat associated with old growth is contained in Section 3.10.

Several vertebrates also depend on the old-growth canopy system for habitat. The large branch systems and related organic accumulations provide habitats for well known species such as the marbled murrelet, northern spotted owl, red tree vole, and northern flying squirrel. The canopy provides nesting, feeding, and protection opportunities for these species. In fact, voles may live for generations in the same tree (Franklin et al., 1981).

PALCO divides its old-growth into two classes: unentered old-growth and selectively harvested old-growth, called residual stands. Unentered refers to stands that have not had any timber harvest. These can be subdivided into coastal stands dominated by redwood and the inland stands dominated by Douglas-fir with scattered redwood. The selectively harvested stands have had some timber harvest but they retain enough of the characteristics of an old-growth forest to be classified as old-growth. There are

approximately 16,911 acres of these selectively harvested stands on PALCO's lands (including both redwood and Douglas-fir; see Table 3.9-1).

In addition to the selectively harvested old-growth stands there are several old-growth redwood groves on PALCO's property. Their makeup is the result of complex interactions of site conditions and disturbance over time. Table 3.9-1 describes the stand types within 12 of these groves.

3.9.1.4 Seral Stages and Forest Types

Seral stages are the series of stages in the process of ecological succession where one plant community is replaced by another until a stable climax community is reached or disturbance restarts the process. The following seral stages have been identified for the PALCO and Elk River Timber Company properties (see Table 3.9-1 and Appendix L-1).

Non-Forest—Meadows and rocky areas that do not support forest vegetation.

Forest opening—Areas with grass, brush and conifer seedlings and saplings up to one inch in diameter at 4.5 feet from the ground (dbh).

Hardwoods—Areas dominated by broadleaf trees such as tanoak and madron*e*

Young forest—Areas with saplings between 1 inch and 11 inches dbh. Stands are generally between 10 and 20 years old.

Mid seral forest—Areas with trees 12 to 24 inches dbh. Stands are generally 20 to 50 years old and lack a shrub layer.

Late seral forest—Areas with trees that average over 24 inches dbh and that have begun to develop a multi-storied structure. It occurs in some redwood stands as young as 40 years but usually in stands more than 50 years old. (Late seral includes forests classified under the California Wildlife Habitat Relationships [WHR] system as late-successional types 5M, 5D, and 6).

Old growth—Technically, these stands are part of the late-successional seral stage but they are listed as a separate stage by PALCO. They generally have multiple canopy layers dominated by trees over 30 inches dbh, with a shrub and herb layer and high snag and down log levels. PALCO only includes unentered stands as old-growth stands. Previously harvested stands with residual old-growth trees are included in the old-growth category.

3.9.1.5 Rare and Uncommon Flora

Rare plants contribute to the biological diversity of the redwood forest ecosystem. The ESA generally prohibits federal agencies from taking actions which would jeopardize the continued existence of plants listed or proposed to be listed by FWS. CEQA requires consideration and avoidance of effects on significant plants, which are defined as those designated as threatened or endangered by FWS, as threatened, endangered, or rare by CDFG, or any species included on the California Native Plant Society (CNPS) Lists 1A, 1B, or 2.

The numbers and distribution of rare plants in the redwood ecosystem reflect, in part, the diversity of substrata, microclimates and land uses. Because of their patchy distribution, occurrence of many rare plants can only be ascertained by field surveys conducted at the appropriate time of year, by qualified personnel, and at sufficient sampling detail to include the relatively small patches of potential habitat that might be distributed across the survey area. The area affected by the proposed SYP/HCP and land acquisitions comprises over 200,000 acres, very little of which has been thoroughly surveyed for rare flora.

Records of historic and contemporary sightings of rare plants are maintained by FWS, CDFG, and CNPS. Known

occurrences of plants on lands owned by PALCO or Elk River Timber Company were obtained from the CDFG Natural Diversity Data Base GIS (NDDB). Records of rare plants tracked by CNPS are retrievable by individual 7 1/5 minute US Geological Survey quadrangle.

Plant species included on the HCP List B are included on Table 3.9-4, along with their rarity status and general habitat. Table 3.9-4 includes all plant species which are rare, threatened or endangered and which are known to grow on habitats which might occur on PALCO or Elk River Timber Company lands involved in the proposed action. A species is considered rare, threatened or endangered if it is designated (or proposed) by FWS as threatened or endangered, is listed by CDFG as endangered, threatened or rare, or included on CNPS Lists 1A, 1B or 2. The table is based on information contained in the CNPS Electronic Inventory (version 1.5.0), CDFG NDDB GIS, and the HCP.

FWS identified five listed or proposed threatened or endangered plant species that might be affected by the proposed action: *Lathyrus biflorus* (Candidate), *Erysimum menziesii* (Endangered), *Layia carnosa* (Endangered), *Lilium occidentale* (Endangered) and *Thlaspi montanum var. californicum* (Proposed endangered) (letter from Bruce Halstead, FWS, dated April 14, 1998). *E. menziesii* and *L. carnosa* are not included on Table 3.9-8 because the coastal dune and beach habitats on which these two species occur are not found on PALCO or Elk River Timber Company lands.

No threatened, endangered, candidate or proposed plant species have been reported on PALCO or Elk River Timber Company properties, but occurrences of rare plants on these lands have not been surveyed. Six of the species included on Table 3.9-4 have been reported from hydrologic units that contain PALCO property that would be subject to the HCP. *Calamagrostis foliosa* has been reported from the Mattole Delta unit; *Carex leptalea* and *Lillium occidentale* from the Elk River unit; *Monardella villosa ssp globosa* from the Lower Eel River unit; and *Sidalcea malviflora ssp patula* from the Van Duzen unit. *Sidalcea malachroides* has been reported from ten hydrologic units that contain PALCO HCP lands (CDFG NDDB). *Lilium occidentale* is listed by FWS and California as Endangered; *Calamagrostis foliosa* is listed by California as Rare. The other six species are included on CNPS Lists 1B or 2.

A variety of habitats found on the PALCO and Elk River Timber Company properties support rare flora. Broadly defined, habitats supporting plants listed in Table 3.9-4 include coastal prairie, chaparral, cismontane woodland, broadleafed upland forest, coniferous forest and wetlands. Some species typically associate with serpentine substrate; others associate with marshes and wet meadows. For a number of the species, however, habitats encompass a broad category of physical conditions or not well documented. Without field surveys, therefore, occurrence of rare flora on lands affected by the proposed action is difficult to predict.

3.9.1.6 Commercial Timber

Forests provide society with sustained timber harvests where old-growth productivity can be maintained due to favorable environmental factors and management policies permit. Environmental factors include local climate and soils that support the growth of commercially valuable tree species. Lands where environmental factors permit commercial harvest are identified as "tentatively suitable" for timber production. Privately owned suitable lands are generally available for harvest subject to regulation by the California FPR.

Table 3.9-4. Plant Species with Federal or State Status

Table 3.9-4, page 2

Timber harvest on privately owned land in California is governed by the Z'berg-Nejedly Forest Practice Act of 1973 as amended. The California FPR implements the provisions of the Act consistent with other environmental laws, including the Timber Productivity Act of 1982 and the CEQA of 1970. Under these rules timber harvest on ownerships greater than 50,000 acres must be preceded by an approved sustained yield plan and a timber harvest plan.

Generally, a timber harvesting plan (THP) must be submitted and approved before harvest on PALCO lands. A sustained yield plan does not replace a timber harvest plan; however, sustained timber production, watershed impacts, and fish and wildlife issues addressed in an approved sustained yield plan will not have to be addressed again in the timber harvest plan. Except under emergency circumstances, substantial deviation from the sustained yield plan may not be undertaken in the timber harvest plan unless an amendment has been submitted and approved by the Director of the CDF following the same procedures used in approving the original sustained yield plan. No timber harvest plans may be approved which rely upon a substantial deviation proposed in an amendment to a sustained yield plan until such a deviation is approved by the Director. Minor deviations must be reported to the Director immediately in writing, but do not require amendment of the plan.

If an approved THP is violated, the Registered Professional Forester (RPF) who authored the plan, the land owner, and the operator are all subject to administrative and judicial penalties (California FPR, 1997).

3.9.1.7 Site Quality

Foresters use site quality as a measure of the relative productive capacity of a parcel of land. Site index is based on the total height of a tree at a given age. Lands are divided into site classes or quality types. Each site class contains a range of site index numbers.

PALCO lands fall into five site classes as follows: Site 1, 2 and 3 (Site 1 being the best growing site) are forest lands appropriate for growing timber, and Site 8 and 9 are lands of poor potential, frequently dominated by hardwoods, and to be maintained for wildlife habitat. Over 90 percent of PALCO's lands are Site 2. Site 2 land is capable of producing conifer trees between 155 and 179 feet high in 100 years (Lindquist and Palley, 1963; California FPR, 1997).

3.9.1.8 Sustained Yield Plans

The objective of a SYP is to demonstrate how long-term sustained yield will be achieved during the planning period while protecting soil, water, air, fish, and wildlife resources. It is intended to supplement the THP process by providing a means for addressing long-term issues of sustained timber production and cumulative effects analysis (California FPR, 1997). The planning period for PALCO's sustained yield plan is 120 years. In addition to the name and address of the owner, a sustained yield plan must contain the following:

- Ownership description and location, including legal description and maps depicting the ownership and management units which shall be at a scale sufficient to allow the Director to determine the area covered by the plan;
- Management objectives for resources addressed in the plan including timber products;
- General narrative description of the forest types, fish and wildlife habitats and watercourses and lakes;
- Descriptions of management units (e.g., planning watersheds or larger areas) and rationale for management unit selection;

- Identification and mapping of planning watersheds classified as sensitive watersheds and description of the measures taken to protect resources within those watersheds;
- A sustained timber production assessment;
- A fish and wildlife assessment; and
- A watershed assessment and related planning.

Silvicultural Systems

The practice of silviculture takes into account the interaction of topography, geomorphology, soils, climate, plant communities, and tree physiology in determining how a stand of trees is tended, harvested, and regenerated to achieve future stand condition. Silvicultural practices are directed at creating and maintaining the type of forest that will fulfill management objectives including wildlife and fisheries habitat.

Silvicultural practices in the redwood region primarily focus on managing forest stands to grow redwood and Douglas-fir. The silvicultural characteristics of both species are similar, resulting in similar silvicultural prescriptions. Several silvicultural systems are used in the region to accomplish management objectives. The systems take into consideration the ecological characteristics of the stand and the physical features of the terrain. These systems include using silvicultural prescriptions that create or maintain even and uneven aged stand conditions.

Harvest Prescriptions

Clearcut—The practice of harvesting all trees on a specific site and establishing regeneration through natural or artificial methods (natural seeding or planting). Decisions to clearcut are usually based on a number of factors, including topography, economics, volume production goals, stand health, species composition, and future management goals including the desire to produce even-aged stands.

Seed Tree—The practice of removing all but a few single standing trees or groups of trees to be used as a seed source. Advantages of this prescription are control of species composition, regeneration of large areas, and reduced planting costs. The disadvantages of this prescription are risk of seed tree blowdown, high cost of harvesting the seed trees after the area is reforested and the damage to established seedlings. Similar to clearcutting, even-aged stands are produced using seed tree prescriptions.

Shelterwood—The practice of harvesting an area with two or more stages over time to ensure regeneration. Naturally regenerated seedlings are protected from extreme weather conditions by residual trees. Residual trees are harvested as soon as restocking goals are met. Advantages of this prescription include better control of stand composition, and control of site conditions to minimize weather damage. The disadvantages of this system include increased harvest cost due to repeated stand entry, residual stand and regeneration damage caused by repeated entry, potential overstocking, and the risk of blowdown to residual trees. Harvest of the trees left in the first state is referred to as overstory removal resulting in even-aged stands.

Single Tree/Group Selection—Individual trees or groups of trees of all ages are removed to create a mosaic of even aged groups. This prescription is normally used to meet silvicultural or visual management objectives. Selective harvests create or maintain uneven-aged stands. The advantages include reduced impacts to the water quality, wildlife habitat, and the viewshed. Disadvantages include higher costs and repeated entries, which can compact soil and damage trees and plants (and usually much higher road densities).

Late Seral—Used to create and maintain multistoried, uneven-aged, late seral forest habitat. Selective harvesting enhances the growth of a few large trees, while creating and maintaining special habitat elements including decadent trees, snags, downed logs, and other woody material (Barrett, 1962; Arvola, 1978).

Pre-commercial Thinning—The practice of harvesting a portion of the trees, usually in a young stand, to enable the remaining trees to grow at a faster rate and/or to a larger size. The cut trees are too small to be sold.

Commercial Thinning—The practice of harvesting a portion of the trees, usually in a young stand, to enable the remaining trees to grow at a faster rate and/or to a larger size. Harvested trees are large enough to be sold.

Timber Harvest Methods and Logging Systems

Topography, silvicultural objectives, and the size and weight of logs are some of the key factors that dictate the type of equipment used to harvest trees. Flatter areas are generally logged using large crawler and rubber-tired tractors to ground skid logs from where they have been cut to transfer points, or landings, to be loaded on trucks and hauled to mill yards. Hillside or steep areas are generally logged using short span elevated cable systems designed to lift one end of the log off the ground and drag it to a landing. In most cases, cable yarding systems have less impact on soils than ground skidding but may require more road building. Both yarding systems are used in a variety of applications that are site specific. Ground skidding has traditionally allowed harvesters the ability to remove selected trees; however, improved equipment design and better engineered cable systems are allowing more selective removal using cable yarding machines.

Herbicide Use

Herbicides are generally used in reforested areas to decrease competition from undesirable plants and allow commercial species the opportunity to maximize their growth potential. Vegetative management techniques include the following:

- Cutting individual trees and shrubs that sprout or grow back after cutting and applying herbicide directly to the stump after cutting
- Girdling them with a knife, saw, or ax and applying herbicide in the cut
- Hand-spraying individual plants.

Aerial application is not proposed. Herbicide uses are strictly controlled and must be applied under the supervision of licensed applicators. Use permits must be obtained from government agencies prior to application, and the chemicals used must be registered for specific use and approved before application. See Section 3.14, Herbicides, as well as Section 3.4, Watersheds, Hydrology, and Floodplains, for a more detailed discussion on this subject.

Growth and Yield Projections

Growth and yield projections generally are based on data collected from field sample plots. This general method has been used since the early part of the century and refined as statistical evaluation methods and computing tools have evolved. Only a small percentage of the species range or ownership is sampled, and the extrapolated data are used to predict growth and yield. If the sample plots do not correctly represent the entire property, the data used from those plots can under or over estimate yields. Modern modeling programs such as FREIGHTS use inventory data for generating projections that are based on measurements from permanent sample plots. They simulate tree growth and are fairly accurate in providing short-term

projections. Data to perform long-term projections are extremely rare or do not exist. The FREIGHTS program allows sophisticated harvesting and silvicultural manipulation and is designed to operate on entire land holdings data.

Formulas using data compiled from growth tables or field data are used to project individual tree and stand growth. Growth rates vary according to site class designations. Electronic data manipulation greatly increases the number of variables that can be included in the formulas currently used. However, while results may be valid for a forest they may not be valid when applied to individual stands within the forest.

A constant dilemma faced by timberland managers is how to apply general growth and yield information to specific parts of forests. Normal sampling error in inventory data and growth yield models can be accounted for algebraically, but the major concern is application of optimistic growth projections that overestimate the volume that may be available for harvest in future time periods, resulting in overcutting in the short term. The lack of sufficient background data to make yield projections forces managers to be conservative in the implementation of the projections. As an example, little or no documentation exists on the long-term effects of intensive management. However, many studies show substantive short-term gains due to intensive management (Biging, 1996; Davis et al., 1997; Arvola, 1978). PALCO and CDF have agreed to a monitoring plan to determine if the growth and yield projections for the 120-year planning interval are correct and if intensive management is successfully implemented as planned.

Long-term Sustained Yield Projections

In general terms, long-term sustained yield (LTSY) is the concept of perpetual harvest of forest products or the numerical measure of the amount of commercial timber annually produced from the commercial timberland portion of a forest ownership. It can also be defined as the average annual growth that will be provided and harvested in perpetuity from implementing a specific mix of silvicultural prescriptions assigned to the commercial timberland base. Overestimation of LTSY can result in the systematic over-harvest of a forest relative to its sustainable harvest capacity. Because LTSY is the growth of a forest at the end of the planning interval, it is critical that growth projections be accurate. Conservative growth estimates contain a buffer sufficient to absorb statistical errors in sampling and projection percent as well as changes in management direction and unforeseen events.

LTSY projections are based on several factors, including initial forest inventory and structure, strength of regulatory and policy constraints, the discount rate, silvicultural prescriptions, wildlife habitat relationships, yield projections, and site index information. Linear programming or other models used for harvesting scheduling assume that growth and yield estimates are correct. The linear program considers all of the variables above in creating a projection. An adequate number of field inventory plots must have been established to provide accurate growth information in order to project realistically. If data are limited, the yield estimate may be either too high or too low. The error might not be apparent for many years.

A model for even-aged prescriptions that uses the mean annual increment of the prescription to estimate the contribution to LTSY and, for uneven-aged prescriptions uses the average growth over specific decades, should ensure reasonable results if the underlying growth and yield projections are accurate. LTSY overestimations of more than five percent are considered to be significant in terms of jeopardizing the

sustainability of the proposed harvest level (Davis et al., 1997; Biging, 1996).

As stated above, LTSY is an estimate of the amount of commercial timber that can be produced from commercial timberland. It does not directly address ecosystem simplification (e.g., the replacement of unmanaged stands with plantations which are less diverse and the effect of this on non-commodity resources). It is possible for a forest to produce a sustained yield of timber but not a sustained yield of habitat for some wildlife or plant species.

3.9.2 Environmental Effects

The following sections describe the environmental effects on PALCO and Elk River Timber Company lands that occur as a result of the five alternatives considered in this EIS/EIR. The environmental effects on natural vegetation, rare and uncommon flora, and commercial timber are discussed. The environmental effects on vegetation and commercial timber production result directly from the amount of area scheduled for timber harvesting, the timing of that harvest, the silvicultural prescriptions allowed, and the types of harvest systems used.

Threshold of Significance

The threshold of significance for development of a SYP is the achievement of maximum sustainable timber harvest consistent with the protection of soil, water, air, fish, and wildlife resources (FPR Section 913.11). CDF's evaluation of the SYP relies upon the HCP. CDF will use the EIS/EIR and its evaluation of the HCP to identify potentially significant adverse impacts and will determine whether the SYP includes feasible measures to mitigate or avoid those impacts. Consequently, CDF will rely on sections such as Section 3.4 (for water quality), 3.8 (for fish), and 3.10 (for wildlife). If significant adverse effects to these resources are avoided or mitigated, and the components related to the LTSY are accurate, the SYP can be approved (FPR Section 1091.10). Substantial reductions in timber volume that are not required to protect soil, water, air, fish, and wildlife resources may exceed the threshold of significance. The threshold of significance for vegetation is whether a range of vegetation types occur on the landscape over time and whether there is a substantial reduction in vegetation types that are regionally restricted. The thresholds of significance related to vegetation's effects on other resources are analyzed in the appropriate resource section. For example, the threshold for marbled murrelet habitat and other wildlife is discussed in Section 3.10.

Correctly determining LTSY is an integral component of the task of evaluating the SYP. The LTSY is based on several factors, including forest inventory, silvicultural prescriptions, site index information, and yield projections. PALCO's site index information covers too narrow a range and its intensive management prescriptions have not been implemented for long enough to determine their full effect on LTSY. Therefore, there may be errors in PALCO's LTSY projections. The same model has been used to calculate growth and harvest for all the alternatives. Consequently, these concerns about the accuracy of the growth and harvest predictions apply to all alternatives, especially those that involve intensive management prescriptions.

Summary of Effects

The environmental effects on vegetation and commercial timber production result directly from the amount of area scheduled for timber harvesting, the timing of that harvest, the silvicultural prescriptions allowed, and the types of harvest systems used. Nearly half of PALCO's land is withdrawn from timber harvest in Alternative 3, approximately one-third in Alternatives 1 and 4, and approximately 10 percent in Alternatives 2 and 2a.

Clearcutting is prescribed for the majority of the land in Alternatives 1, 2, 2a, and 4 and is not permitted in Alternative 3. Alternatives 2 and 2a are projected to have the most tractor logging, ranging from 38,700 to 40,500 acres in the first decade, Alternative 3 would have less than one-fourth as much. These are estimates based on the FREIGHTs modeling. Actual tractor logging would be determined through field examination, including the prescriptions developed through watershed analysis. Therefore, the amount of tractor logging may be much less than what is projected here. It is estimated that about 35 to 40 percent of PALCO's ownership is suitable for tractor logging (D. Opalach, Personal communication, September 9, 1998). Tractor logging results in soil compaction in the skid roads. Though the number of skid roads can be limited by good logging practices, some compaction is unavoidable and this has a negative effect on vegetation growth. Alternatives 2 and 2a would produce the highest timber harvests and Alternative 3 the lowest. Alternatives 2 and 2a would harvest more than a third of the late seral stands in the first 10 years of the SYP. Alternative 1 would harvest more than a fourth.

Based on these factors, Alternatives 2 and 2a, and, to a somewhat lesser extent, Alternative 1, would have the greatest effect on vegetation. They would result in more early seral stands, less structural diversity, and more fragmentation than Alternative 3. Alternative 4 would have effects at an intermediate level.

3.9.2.1 Natural Vegetation

Alternative 1 (No Action/No Project)

The state and federal assumptions for assessing environmental impacts to aquatic resources under the No action alternatives differ due differences in analysis approach required by CEQA and NEPA. CEQA implementing regulations require that an EIR discuss "the existing conditions, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved" [14 C.C.R. 15126(d)(4)]. CEQA does not require either a projection into the long-term future that could be deemed to be speculative, nor does it require a quantitative analysis of the No Project alternative for comparison with the other alternatives. Accordingly, the CDF version of the No Action/No Project alternative analyzed here contemplates only the short term and is based on individual THPs that would be evaluated case by case. The CDF version of No Action/No Project does not attempt to forecast how PALCO's entire property would look in 50 years (the length of the proposed ITP). Since it is unknown how many THPs there would be, where they would lie geographically, and how they would differ in detail, no quantitative analysis of THPs is presented (see Section 2.5).

The likely No Action/No Project alternative would consist of PALCO operating in a manner similar to current THP practices and subject to existing CDF regulatory authority. In reviewing individual THPs, CDF is required to comply with the FPA, FPRs, and CEQA through its certified functional equivalent program (see Section 1.6). The specific criteria for evaluating THPs contained in the FPRs are combined with the case by case evaluation of each THP for significant effects on the environment followed by consideration of alternatives and mitigation measures to substantially lessen those effects. Under CEQA and the FPRs, CDF must not approve a project including a THP as proposed if it would cause a significant effect on the environment, and there is a feasible alternative or feasible mitigation measure available to avoid or mitigate the effect. An adverse effect on a listed threatened or endangered species would be a significant effect under CEQA.

In addition, the present FPRs provide that the Director of CDF shall disapprove a timber harvesting plan as not conforming to the rules if, among other things, the plan would result in either a taking or a finding of jeopardy of wildlife species listed as rare, threatened, or endangered by the Fish and Game Commission or a federal fish or wildlife agency or would cause significant, long-term damage to listed species. To make a determination as to the effect of a THP on listed fish or wildlife species, CDF routinely consults with state and notifies federal fish and wildlife agencies. These processes and independent internal review by CDF biologists can result in a THP containing additional site-specific mitigation measures similar to the ones described in the Proposed Action/Proposed Project. CDF believes that its existing process using the FPRs and the CEQA THP by THP review and mitigation are sufficient to avoid take of listed species.

The mitigation by which an individual THP is determined to comply with FPRs, the federal and California ESAs, and other federal and state laws is determined first by compliance with specific standards in the FPRs and then by development of site specific mitigation measures in response to significant effects identified in the CEQA functional equivalent environmental analysis of the individual THP. A wide variety of detailed mitigation measures tailored to local conditions is applied with the purpose of avoiding significant environmental effects and take of listed species. Measures include, but are not limited to, consideration of slope stability, erosion hazard, road and skid trail location, WLPZ width, BMPs on hillslopes and within WLPZs, and wildlife and fish habitat. Consequently, most significant effects of individual THPs can be expected to be mitigated to a level of less than significant through implementation of the No Action/No Project alternative. In some cases, CDF may determine that it is not feasible to mitigate a significant effect of a THP to a level of less than significant. In such a situation, CDF would have to determine whether specific provisions of the FPRs such as not allowing take of a listed threatened or endangered species would prohibit CDF from approving the THP. If approval is not specifically prohibited, CDF would have to weigh a variety of potentially competing public policies in deciding whether to approve the THP. A THP with a significant remaining effect could be approved with a statement of overriding considerations, but such an approval would be expected to be rare.

As noted in Section 2.5, under NEPA, the degree of analysis devoted to each alternative in the EIS will be substantially similar to that devoted to the Proposed Action/Proposed Project. The federal agencies recognize that a wide variety of potential strategies could be applied that could represent a No Action/No Project scenario and that they would involve consideration of the same mitigation measures as described above. For the purposes of analysis under NEPA, however, these additional mitigation measures are represented as RMZs, rather than management options developed for site-specific conditions. Consequently, the analysis of the No Action/No Project alternative considers the implementation of wide, no-harvest RMZs as well as restrictions on the harvest of old-growth redwood forest to model conditions over the short and long term. Ranges of RMZ width are considered qualitatively because it is expected that adequate buffer widths could vary as a result of varying conditions on PALCO lands.

Under the No Action/No Project alternative, timber harvest would not be allowed on approximately 63,660 acres of PALCO lands, including approximately 58,811 acres of RMZ and 5,140 acres of redwood old growth. In addition, there would be an

unknown amount of residual redwood, possibly occupied by marbled murrelets, that also would not be available for timber harvest. There would be some harvest of other old growth and residual old growth and there may be some loss of trees to windthrow where new clearcuts border old-growth areas, as well as some loss of large down logs and potential snags from salvage harvests. Over the next 50 to 100 years, forests within the riparian management zones would develop into late seral forests, increasing vegetative and structural diversity, and reducing fragmentation of old-growth stands to some extent. The remainder of PALCO lands, approximately 146,174 acres, and approximately 9,468 acres of Elk River Timber Company lands would be intensively managed for timber production. Therefore, there would continue to be large areas of early and mid-seral stands and the remaining old-growth forest would be isolated from other old growth, existing in a fragmented environment connected only by the riparian management zones. In this fragmented environment, old growth and riparian stands would be at greater risk from wind damage than would be the case for alternatives which provide for an unfragmented landscape. Approximately 20 percent of the harvestable portion of PALCO's lands would be recent clearcuts at any time. Forest communities under this type of timber management support fewer species in the tree and lower strata and have much less structural diversity than old-growth forests (FEMAT, 1993). Even age timber harvesting removes entire plant strata, as intensive fire can, but leaves fewer large diameter snags. Subsequent reforestation and vegetation control excludes many native shrubs and trees, reducing diversity. The conversion of some hardwood stands, mixed conifer/hardwood stands, and grassland that resulted from human activity to conifer stands would reduce these plant communities somewhat. The amount of redwood and Douglas-fir would not change. The major effects would be on the late seral (including old growth) component of the redwood and Douglas-fir plant communities.

Table 3.9-1 shows the seral stages by forest type for years 0, 10, and 50 on PALCO land and on PALCO and Elk River Timber Company land combined. Old growth would decrease by about one-third (all of which would be Douglas-fir), and stands with residual old-growth trees (redwood and Douglas-fir) would decrease by about one-half, while early seral (young forest) and mid-seral stands would increase. Old Douglas-fir stands are fairly well represented in the region. The model used to predict seral stages systematically miscalculates the amount of late seral stands in the outer years. Once late seral stands reach a certain size the model moves the stand into the mid-successional stage. Therefore, there is likely to be more late seral and less mid-seral forest than Table 3.9-1 shows. Hardwood declines by about 1,000 acres or about two-thirds over 50 years. These hardwood stands will be converted to redwood or mixed conifer forest, which they may have been originally. Hardwood is well distributed regionally. Prairie acreage declines from 5,687 acres at year 0 to 5,202 acres at year 50. This decline reflects the fact that some areas mapped as prairie are degraded forest lands that are intended for reforestation. The numbers also reflect the fact that the FREIGHTS model is oriented towards existing forests and models prairie habitat well. Wetland and riparian areas are described in Section 3.7. In general, habitats that add diversity (such as hardwoods and prairie) will be reduced over time, although PALCO lands would still contribute to local and regional vegetation patterns. Invasive and noxious weeds would continue to have the potential to occupy some sites, although control efforts would continue. Alternative 1 would have the second highest potential for invasive weeds

because it has the second highest acreage harvested after Alternatives 2 and 2a.

The acres available for harvest and, therefore, the amount of early, mid-, and late seral forest that can be expected over the 50-year period, are partly based on the amount of area within riparian buffers. However, there is uncertainty as to the amount of PALCO land that would actually be included in riparian buffers under this alternative since they range from 170 to 340, 85 to 170, and 50 to 100 feet on Class I to III streams, respectively. Field data from one watershed on PALCO property and experience with similar buffers on federal lands also indicate that there are more Class III streams than can be detected from maps and aerial photographs. For example, in the Freshwater Creek watershed, field examination showed that there are approximately 78 percent more Class III streams than were mapped. If this is the case across the ownership, far fewer acres would be available for harvest. Also, experience on National Forest System land shows that the large network of riparian reserves (approximately 65 percent of the land base) results in isolating many small, patches of forest technically available for harvest. Many of these areas cannot be reached with ground-based or cable systems, however, which further reduces the area actually available for harvest (Personal communication, P. Hicks, Siskiyou National Forest and M. Wilson, Mt. Baker-Snoqualmie National Forest). Together, these reductions in harvest would result in more late seral forest and less early and mid-seral forest over the next 50 years than is estimated here. On the other hand, buffer widths may be only half the distances modeled for this alternative (170, 85, and 50 feet on Class I, II, and III streams, respectively) instead of 340, 170, and 100 feet. This would more than compensate for the added Class III stream buffers, resulting in more harvest, less later seral forest and more early and mid-seral forest than was modeled.

Approximately 9,468 acres of Elk River Timber Company lands would continue to be managed for timber. None of these lands would be withdrawn from harvest to buffer existing old-growth stands. This may result in increased windthrow of old-growth trees when Elk River Timber Company harvests stands adjacent to PALCO property containing old growth.

Alternative 2 (Proposed Action/Proposed Project)

Under Alternative 2 there would be no harvest on approximately 11,290 acres of PALCO land (including 3,769 acres of no-harvest stream buffers and 7,521 acres in MMCAs, Table 3.9-2). Approximately 26,123 acres would be selectively-harvested RMZ to protect riparian habitat. The riparian areas would have individual tree harvest as often as every 20 years except within the restricted harvest band (see Section 3.7 for a discussion of buffer requirements). The objective would be to develop or retain a multi-layer tree canopy with large trees, down wood, and snags. Both vegetative and structural diversity would be higher than in the intensively managed areas but less than in the much larger no-harvest riparian reserves proposed in Alternative 1. At least 10 percent of PALCO's lands in each watershed would be maintained as late seral forest, but approximately 69 percent of residual old growth would be harvested within the first 10 years of the SYP (Table 3.9-1). About 20 percent of residual Douglas-fir would remain at both 20 and 50 years. About 36 and 27 percent of residual redwood would remain at years 10 and 50, respectively. About 63 percent and 41 percent of old-growth Douglas-fir would remain at years 10 and 50, respectively. About 61 percent of old-growth redwood outside of the Headwaters Reserve would remain at years 10 and 50.

Old growth within the 7,503-acre Headwaters Reserve would be preserved and young stands within the Reserve, which would include lands transferred from the Elk River Timber Company, would develop into old growth over the next 150 to 200 years. In the meantime, they would provide a buffer, protecting the existing old-growth trees from windthrow. The remainder of PALCO lands, approximately 174,386 acres, which would include lands transferred from the Elk River Timber Company, would be intensively managed for timber production. Therefore, these remaining old growth stands would largely be isolated from other old-growth areas by the early and mid-seral stands. In this fragmented environment they would be at somewhat greater risk from wind damage than would be the case for alternatives which provide for an unfragmented landscape.

Table 3.9-1 shows the seral stages by forest type for years 0, 10, 50, and 120 on PALCO land and on PALCO land plus the Reserve. Most of the old growth and stands with residual old-growth trees outside of the Reserve will be harvested, late seral forest would decrease by about one-third, while early and mid-seral stands will increase. Hardwood conversion would be similar to Alternative 1, but more grassland would be converted to conifers. As described under Alternative 1, the areas converted to coniferous forest were likely that vegetation type originally. Less riparian area would be protected (see Section 3.7) than under Alternative 1. Much of the area harvested near streams, however, would not be true riparian habitat. That is, these areas may influence near-stream habitat but they are often not distinctive vegetation types influenced by the presence of stream water. Effects on wetlands are discussed in Section 3.7. Most wetlands would be protected within RMZs. In general, habitats that add diversity (such as old-growth, hardwoods, and prairie) would decline over time. Additionally, old growth Douglas-fir stands are fairly well represented regionally. At the end of 50 years the area outside of MMCAs and RMZs on PALCO ownership would be dominated by early and mid-seral forests. The reduction in prairies and hardwood would reflect conversion back to their original coniferous habitat. Despite these changes, PALCO lands would still contribute to local and regional natural vegetation patterns. Invasive and noxious weeds would continue to have the potential to occupy some sites, although control efforts would continue. Alternative 2 would have the highest potential for invasive weeds because it has the highest acreage harvested after Alternatives 2a and 1, respectively. The effects on natural vegetation communities are, therefore, considered less than significant.

Alternative 2a (No Elk River Property)

Alternative 2a is similar to Alternative 2 except that no Elk River Timber Company lands would be acquired. Approximately 10,782 acres would not be available for timber harvest on PALCO lands, nearly the same as in Alternative 2. This includes 7,521 acres in MMCAs (Table 3.9-2) and 3,561 acres in no-harvest RMZ outside the MMCAs. Approximately 24,894 acres would be selectively harvested to protect riparian habitat as described for Alternative 2. Approximately 168,419 acres on PALCO and nearly all of the Elk River Timber Company lands would be available for intensive timber management. Some old-growth trees in portions of the Headwaters Reserve next to new clearcuts on the Elk River Timber Company lands may be lost to windthrow, since these lands would not be included in the Reserve and would not provide a buffer. Because they would continue to be managed for timber production, they would not develop into old growth over time, as in Alternative 2. Table 3.9-1 shows the seral stages by forest type for years 0, 10, 50, and 120, including

the 5,739-acre reserve. Most of the old growth and stands with residual old-growth trees outside of the Reserve would be harvested, mostly in the first 10 years of the SYP, late seral forest would decrease by more than one-third while early and mid-seral stands would increase. Other changes in vegetation and invasive weeds are very similar to Alternative 2. Consequently, the effects on natural vegetation communities would be less than significant.

Alternative 3 (Property-wide Selective Harvest)

No harvest would be allowed on approximately 88,797 acres of PALCO lands. This no-harvest area would consist of approximately 57,797 acres of old growth and old-growth residual (including 600 buffers) and about 14,000 acres of no-cut RMZ outside of these areas. Only selective harvest would occur on the remainder of PALCO's property. No clearcuts or other even aged harvesting would be allowed. At least 20 percent of PALCO's lands would be maintained as late seral forest and the rest would be managed to develop a multi-layer tree canopy with large trees, down wood, and snags. Over 16,000 acres of residual old growth and over 6,000 acres of old growth (both redwood and Douglas-fir) would not be harvested, and no salvage would occur. There would also be 600-foot buffers around these areas. No-harvest riparian management zones would be maintained on all Class I, II, and III streams, until watershed analyses and site-specific analyses are completed. Approximately 14,000 acres of RMZ would be no-harvest, and 23,228 acres would be available for selective harvest after these watershed analyses are complete. Both vegetative and structural diversity would be much higher than in the intensively managed areas under Alternatives 1, 2, 2a, and 4. Fragmentation would be lower than in other alternatives, reducing the risk to old-growth stands.

Table 3.9-1 shows the seral stages by forest type for years 0, 10, 50, and 120 on PALCO land and for PALCO and Elk River Timber Company lands and the 7,503-acre Reserve combined). Old growth and stands with residual old-growth trees outside of the Reserve would decrease by one-eighth; late seral forest would more than double; mid-seral stands would decrease; and very little early seral would remain. There would be little change in riparian or wetland plant communities. Hardwood would be reduced more than under Alternatives, 1, 2, or 2a. The model predicts that prairie acreage would increase, likely reflecting the less intensive management under this alternative. Most wetlands would be within RMZs. Invasive and noxious weeds would continue to have the potential to occupy some sites, although control efforts would continue. Alternative 3, which has the lowest acreage harvested of all the alternatives and does not allow clearcutting, would not result in large openings and would have the least risk of invasive weeds of all the alternatives. However, the need for repeated entry associated with selective timber harvest could produce disturbed sites susceptible to invasive or noxious weed occupation. Overall, the effects on natural vegetation/vegetation communities would be less than significant.

Alternative 4 (63,000-acre No-harvest Public Reserve)

Alternative 4 preserves approximately 63,673 acres as a no-harvest public reserve. It would comprise approximately 58,996 acres of PALCO land and approximately 4,677 acres of Elk River Timber Company Land. The remaining PALCO lands would be managed as described in Alternative 2. No-harvest riparian reserves would be maintained on approximately 2,585 acres outside the Reserve. Approximately 19,109 acres would be available for selective harvest. Therefore, about 129,144 acres would be

available for intensive timber management. Both vegetative and structural diversity would be higher than in the Alternatives 1, 2, and 2a. Fragmentation would be lower over time; because fewer roads would be needed in the 63,673-acre no-harvest Reserve, old-growth stands would be at the least risk from wind damage.

Table 3.9-1 shows the seral stages by forest type for years 0, 10, 50, and 120 on PALCO land and for PALCO and Elk River Timber Company lands and the 63,000-acre Reserve combined. Old growth and stands with residual old-growth trees outside of the Reserve would decrease by more than one-half; late seral and mid-seral forest would increase somewhat; and early seral stands would increase in the first decade, then decrease. Invasive weed potential and changes in hardwoods and grasslands would be similar to Alternative 2. Riparian and wetlands protection are also similar to Alternative 2. Consequently, the effects on natural vegetation are considered less than significant.

3.9.2.2 Rare and Uncommon Flora

The proposed HCP/SYP and land acquisition alternatives can directly affect rare and uncommon plants through timber removal, road construction or cattle grazing. The proposed actions could also indirectly affect rare plants by altering habitat through management practices such as thinning and stand age, which can change microclimates, through changes in surface water drainage which can increase or decrease soil moisture, or through the inadvertent introduction of aggressive non-native species. If not mitigated, both direct and indirect actions associated with the proposed action could significantly adversely affect rare plant resources in the Project Area.

Alternative 1—(No Action/No Project)

As explained in Section 2.5 and Section 3.9.2.1, the evaluation of the No Action/No Project Alternative under CEQA differs from the evaluation under NEPA. Under CEQA, the No Action alternative is not projected into the long-term future. In the short term, the conformance with the FPRs, the federal and California ESAs, and other federal and state laws is determined on a THP and site-specific basis. A wide variety of mitigation measures tailored to local conditions is applied with the purpose of avoiding significant environmental effects and take of listed species. Consequently, most significant environmental effects of individual THPs can be expected to be mitigated to a level of less than significant through implementation of the No Action/No Project alternative.

Under NEPA, evaluation of the No Action alternative requires consideration of the short- and long-term effects of implementing wide, no-harvest, RMZs, as well as restrictions on the harvest of old-growth redwood. Under the NEPA analysis, ranges of RMZs are considered qualitatively because it is expected that adequate buffer widths could differ as a result of varying conditions on PALCO lands.

Under the No Action/No Project alternative, no PALCO or Elk River Timber Company lands would be acquired and placed in a public reserve with long-term protection. RMZ prescriptions, however, would restrict timber harvesting (except for salvage) from approximately 68,498 acres, including late successional and old-growth forest (marbled murrelet habitat) and RMZ. The north coast coniferous forests, wetlands, and riparian lands, which comprise much of the acreage restricted from timber harvesting, provide potential habitat for a number of the rare and uncommon plants listed on Table 3.9-4. The No Action alternative removes much more acreage from timber management than either Alternative 2 or 2a, but would provide no opportunity for management or long-term protection of rare

plants that would result from public ownership. As noted above, however, effects on rare plants under this alternative would be reduced to less than significant through (required) review and, where necessary, modification of individual THPs on a site-specific basis.

Alternative 2—(Proposed Action/Proposed Project)

The proposed action would transfer 7,503 acres of PALCO and Elk River Timber Company lands to a public reserve. No threatened, endangered, or rare plants are known to occur on these lands, but they have not been thoroughly surveyed. The lands to be acquired comprise extensive late successional/old-growth north coast coniferous forest. In the surrounding region, this forest supports western lily (*Lilium occidentale*), which is federal and state endangered, and leafy reed grass (*Calamagrostis foliosa*), which is listed as rare by California. These species and others included on Table 3.9-4 that are associated with north coast coniferous forests or (non-coastal) wetlands might occur on the lands proposed for acquisition and would be afforded greater protection as a result of the proposed action.

22,000 acres, including the lands acquired for a public preserve, would be removed from timber harvesting, compared to about 68,500 acres under the No Action alternative. The 211,799 acres of land that would be retained by PALCO and managed under the HCP/SYP include areas immediately adjacent to known populations of leafy reed grass, flaccid sedge (*Carex leptalea*), western lily, running pine (*Lycopodium clavatum*), Siskiyou checkerbloom (*Sidalecea malvaeflora ssp. patula*), maple-leaved checkerbloom (*Sidalecea malachroides*), and round-head coyote mint (*Monardella villosa ssp. globosa*). Because of the large area of land, the variety of habitats included therein, and the lack of field investigation, other species included on Table 3.9-8 could occur on lands that would be retained by PALCO and managed under the HCP/SYP.

Serpentine substrates occur as scattered pockets throughout the PALCO lands, and might support glandular western flax (*Hesperolinum adenophyllum*) and other species with an affinity for serpentine soils, listed in Table 3.9-4. The only known population of Kneeland prairie pennycress (*Thlaspi californicum*), proposed for federal listing as endangered, occurs as two colonies on coastal serpentine prairie immediately adjacent to the Kneeland Airport [Federal Register, February 12, 1998, 63 (2):7112-7117]. The Kneeland airport is located within about a mile and a half of property recently acquired by PALCO near the northeastern portion of its holdings. Efforts reported by the FWS to locate additional populations of this species on serpentine outcrops in the vicinity of the airport have failed, and the occurrence of this species may be restricted to this one location. PALCO has investigated the occurrence of this species on its recent acquisition as part of a THP and has also not found it (S. Chennici, PALCO, Personal communication, September 4, 1998)

Ten species listed on Table 3.9-4 have been assigned a wetland indicator status of facultative wet (FACW) or obligate (OBL), indicating a proclivity for wetland habitats. Under Proposed Action, riparian buffers would be excluded from, or have reduced, timber harvest and impacts to wetland habitats associated with riparian buffers would be minimized.

Direct impacts of the proposed action on threatened, endangered or rare plants growing on lands that would be retained by PALCO would depend on where the plants occurred. Of the 211,799 acres of land that would be retained by PALCO, 170,000 would be available for timber harvest. The 22,000 acres removed from harvesting would include RMZs and probably a

substantial portion of the wetland and marsh habitats, which tend to occur near streams. Rare plants that grow in these habitats would be less likely to be affected by timber harvest, but could be grazed or trampled by cattle. Based on known occurrences in the region surrounding the PALCO lands and habitat requirements of each species, leafy reed grass, round-head coyote mint, maple-leaved checkerbloom, Siskiyou checkerbloom, and running pine would be more likely to be affected than other species. These five species have been reported from hydrologic units containing PALCO lands subject to the conditions of the HCP or, in the case of running pine, occur on seven-and-a-half minute quadrangles containing PALCO lands. None of these five species is closely associated with wetlands or riparian buffers.

The extent to which plant resources are affected by the proposed action will depend on the thoroughness of pre-harvest botanical surveys and opportunities to manage any identified populations of rare species. In the absence of mitigative measures, particularly pre-harvest field inspection and appropriate avoidance of any identified populations, the proposed action could significantly adversely affect one or more threatened, endangered, or rare plant species that might occur on lands retained under PALCO management. Consequently, the effects of this alternative are considered significant.

Alternative 2a—(No Elk River Property)

Effects of Alternative 2a on rare plant resources would be similar to those described for Alternative 2. No threatened, endangered, or rare plant species have been reported from lands that would be acquired from the Elk River Timber Company as part of Alternative 2, but these lands have not been surveyed (CDFG NDDB). Alternative 2a would incur less opportunity for long-term protection and management of rare plants occurring on the lands placed into a public reserve, because 5,739 acres would be acquired from PALCO compared to 7,503 acres under Alternative 2. The effects of this alternative are considered significant.

Alternative 3—(Property-wide Selective Harvest)

Alternative 3 would remove over 90,000 acres from timber harvest, including the Headwaters Reserve. The additional acreage encompasses a variety of plant habitats, which might support species associated with north coast coniferous forest, wetlands, or other habitats (Table 3.9-4). The remaining acreage would be subject to selective harvesting, but not clearcutting. Selective harvesting of about 36,700 acres (depending on results of watershed and site-specific analyses) would incur significant risk of adverse effects on rare plants if field surveys were not conducted before cutting. The effects of this alternative are considered significant.

Alternative 4—(63,000-acre No-harvest Public Reserve)

The potential effects of this alternative would be similar to the proposed action but with greatly increased opportunity to provide long-term protection for rare and uncommon species. Approximately 63,673 acres of PALCO and Elk River Timber Company land would be acquired for placement in a public reserve. An additional 2,183 acres of old-growth or marbled murrelet habitat and 2,585 acres of riparian land would also be removed from timber harvest. The acreage acquired for the reserve and the marbled murrelet habitat comprise mostly old-growth north coast coniferous forest. Approximately 68,441 acres containing north coast coniferous forest and wetland (associated with riparian lands) habitats would be removed from timber cutting.

Approximately 134,000 acres would remain for intensive timber management. Potential habitat for rare plants on this acreage would be subject to clear cutting and selective harvesting. As with all of the alternatives except no-action, timber harvest and grazing could significantly adversely affect one or more rare plant species if field surveys and appropriate avoidance measures were not implemented before cutting. The effects of this alternative are considered significant.

Cumulative Effects on Rare and Uncommon Flora

Under all of the alternatives, populations of rare or uncommon plants in the region surrounding PALCO lands would continue to diminish as a result of expanding pressures from a growing human population. The alternatives involving acquisition of land for the Reserve and pre-harvest botanical surveys would lessen the rate at which rare populations are eliminated.

3.9.2.3 Commercial Timber

Alternative 1 (No Action/No Project)

As noted in Sections 2.5 and 3.9.2.1, the evaluation of the No Action/No Project alternative differs under CEQA and NEPA. For CEQA, the No Action alternative is not projected into the long-term future. In the short term, the conformance with the FPRs, the federal and California ESAs, and other federal and state laws is determined on a THP and site-specific basis. Compliance is attained by a wide variety of mitigation measures tailored to local conditions such that significant environmental effects and take of listed species are avoided. Consequently, most significant environmental effects of individual THPs can be expected to be mitigated to a less than significant level through implementation of the No Action/No Project alternative.

As noted in Sections 2.5 and 3.9.2.1, the NEPA evaluation of the No Action/No Project alternative considers the implementation of wide, no-harvest RMZs, as well as restrictions on the harvest of old-growth redwood forest to model conditions over the short and long term. Ranges of RMZs are considered qualitatively because it is expected that adequate buffer widths could vary as a result of varying conditions on PALCO lands.

As noted in the discussion of Natural Vegetation for Alternative 1, the actual acreage available for harvest, and consequently the available timber volume, could be substantially lower than indicated. Buffers on Class III streams can encompass large areas as well as isolating other areas from timber harvest.

Under Alternative 1 approximately 146,174 acres would be managed intensively for timber production. No timber harvest would be allowed on approximately 63,660 acres of PALCO lands, including a minimum of 58,811 acres of no-harvest riparian buffers. Only limited salvage logging would be permitted on approximately 4,849 acres of redwood old growth. Intensive management techniques, such as site preparation, planting improved stock, herbicide application to control competing vegetation, and thinning to concentrate growth in the crop trees, would be expected to result in higher growth rates on areas available for timber management than under past management. Silvicultural systems for each alternative are listed in Table 3.9-5.

Timber typically is measured in units of 1,000 board feet net (mbfn). One mbfn equals the amount of wood in 1,000 boards which are 1 foot long, 1 foot wide, and 1 inch thick. Tables 3.9-6a through 3.9-6j summarize the projected volumes of standing timber, the growth, and the harvest in 10-year increments over the 120-year plan for each alternative, beginning in

Table 3.9-5. Silvicultural Method in the First Decade (approximate acres)

Alternative	Clearcut	Seed Tree	Overstory Removal	Commercial Thin	Selection
1	26,447	865	2,060	8,427	1,493
2	34,903	866	2,165	12,549	3,902
2a	33,256	866	2,165	12,510	3,715
3	4,545[1/]	441[1/]	1,522[1/]	3,262	123,003
4	24,901	574	1,389	8,112	2,988

[1/] These harvest are the result of already approved timber harvest plans.
Source: Vestra Resources

2001, based on PALCO's LTSY model. The potential LTSY volume for Alternative 1 is 2,074,054 mbfn per decade (Table 3.9-6a). The accuracy of these projections is discussed under Alternative 2. Table 3.9-6a shows that growth exceeds harvest on PALCO lands throughout the period for Alternative 1. This results from the growth on areas off limits to timber harvest, mostly in the riparian reserves. Therefore, this alternative would be substantially below LTSY (approximately 60 percent). This would result in a less than significant loss of production. Projected timber harvest in decade one on PALCO lands is 1,712,518 mbfn (Table 3.9-6a).

Under this alternative, there would be no transfer of Elk River Timber Company lands. Table 3.9-6b shows the total projected volumes of standing timber, the growth, and the harvest for both PALCO and Elk River Timber Company land. The harvest volume for Elk River Timber Company land is 12,954 mbfn per year for the first decade.

Tables 3.9-6a through j show the projected acres by harvest system for each alternative for PALCO lands and for all ownerships (PALCO, Elk River Timber Company, and the federal/state reserve). These are only estimates; actual harvest systems would be based on site-specific decisions made in each timber harvest plan. The model predicts that Alternative 1 has approximately 29 percent cable yarding and 71 percent tractor yarding. It is likely that on-the-ground analysis would result in less tractor yarding and more cable yarding.

Alternative 2 (Proposed Action/Proposed Project)

Under Alternative 2, PALCO's lands would be managed under their proposed HCP and SYP. Approximately 174,386 acres would be managed intensively for timber production and approximately 26,123 acres selectively harvested to protect riparian habitat. The riparian areas would have individual tree harvest as often as every 20 years. The objective would be to develop or retain a multi-layer tree canopy with large trees, down wood, and snags. Approximately another 3,769 acres of riparian areas would not be harvested. The 7,503-acre Headwaters Reserve would not be available for timber harvest, nor would approximately 7,521 acres of marbled murrelet habitat (Table 3.9-2). The model predicts that Alternative 2 has approximately 26 percent cable yarding and 74 percent tractor yarding.

In order to ensure that PALCO is managing its land on a sustained yield basis and to meet the other requirements of the law, PALCO proposes the following guidelines:

Table 3.9-6a. Alternative 1 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Table 3.9-6b. Alternative 1 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Table 3.9-6c. Alternative 2 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Table 3.9-6d. Alternative 2 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Table 3.9-6e. Alternative 2a Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Table 3.9-6f. Alternative 2a Projected Harvest, Growth and Inventory Volumes, All Ownerships

Table 3.9-6g. Alternative 3 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Table 3.9-6h. Alternative 3 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Table 3.9-6i. Alternative 4 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Table 3.9-6j. Alternative 4 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Table 3.9-7. Yarding Method on PALCO Lands for the First Decade For Each Alternative (approximate acres)

- At least five percent of PALCO's forested lands in each WAA will be mid-seral.
- Between decades, maximum harvest levels would not increase or decrease by more than 15 percent between the first and second decade, 12.5 percent between the second and third decade and 10 percent thereafter. Harvest volumes would be tracked quarterly and reported to the California Department of Forestry yearly.
- Harvests per decade must be less than LTSY, with average growth computed as the mean annual periodic increment of the last four planning periods for uneven-aged prescriptions and as the mean annual increment for even-aged prescriptions.
- PALCO timberlands in each WAA should include at least five percent forest opening, five percent young forest, five percent mid-successional, and 10 percent late seral forest at all points in the Plan period (excluding WAA 6).
- The harvest of old-growth should be phased over the first two decades of SYP implementation.
- Throughout the Plan period, at least 10 percent of PALCO timberlands in each WAA (excluding WAA 6) should be suitable nesting habitat for northern spotted owls.
- The Disturbance Index (DI) for PALCO lands in each WAA (excluding WAA 6) should not exceed 20 percent at any point in the Plan period.
- WLPZs should average a 170-foot slope width along Class I streams with an 100-foot slope width along Class II streams.
- Harvests within 30 feet of Class I streams and 10 feet of Class II streams should be limited to treatments that will enhance (or, if the riparian system is not impaired, maintain) riparian conditions.
- Harvests in the 30- to 100-foot buffer of Class I streams would have a dense late seral selection prescription applied (i.e., minimum basal area of 300 sq. ft/acre with size retention standards).
- Harvests in the 100- to 170-foot buffer of Class I streams and in the 10- to 100-foot buffer of Class II streams should be limited to the regular late seral prescription (i.e., minimum basal area of 240 square feet per acre with size retention standards). Only single tree selection harvest methods should be used in these buffer areas.
- Harvest within 300 feet of suitable marbled murrelet habitat on adjacent public lands should be limited to the regular late seral prescription (i.e., selection harvest every 20 years, 240 square-foot-per-acre stand retention after).

The LTSY volume is 2,335,200 mbfn per decade. Projected timber harvest in decade one on PALCO lands is 2,335,188 mbfn (Table 3.9-6c) Tables 3.9-6c and d show that the proposed harvests in the first two decades exceeds growth for those decades for this alternative. PALCO assumes that once the old-growth, hardwood, and poorly stocked stands planned for harvest in the first two decades are cut and those areas put into intensive management, growth rates will exceed harvest rates. PALCO believes the success of these practices is well established and that the large intensive management program it currently operates has given it the expertise necessary to implement it during the coming decades.

An independent review of the methods used by PALCO to project yields on its lands was prepared by Dr. Greg S. Biging (PALCO, 1998, Volume III; Appendix F). He concluded that the procedures chosen by PALCO and its consultants were reasonably

selected, but that there were not enough data on stand growth, particularly of the intensively managed stands, to predict yields adequately. However, based on his analysis and his knowledge of the models used, he thought that the projections in the SYP were conservative and that the true yields would be expected to surpass those projected. He recommended that more inventory plots be used, that harvests dates be tracked better, and that site index estimates be improved in order to improve the overall accuracy of the yield estimates. Because harvest is based on growth and yield, accurate estimates are very important.

PALCO's sampling for site class was done in clustered plots in harvest units rather than distributing them across the property as would be done in a statistically valid sampling design. Therefore, the validity of the site class estimates is unknown. Also, the company may not be able to successfully implement the intensive management program that they are proposing and upon which their LTSY improvements are based. Techniques such as vegetation control are not always successful when implemented and there may not always be resources available to finance them. PALCO proposes to manage its land intensively and bases its LTSY, in part, on accomplishing this level of intensive management. PALCO has not managed its land using these intensive management practices until recently. Therefore, there is no record to judge PALCO's likely success at achieving the projected growth increases. If higher harvest during the first two decades are not followed by a continuing and successful intensive management program, there will be a considerable decrease in timber available for harvest in the following decades. Also, there are no long-term studies in the redwood region which demonstrate the effect of intensive management on LTSY. Therefore, the long-term result of intensive management cannot be quantified. Even if PALCO's assumptions prove correct, their growth and yield projections estimate that there will be a significant decrease in timber available for harvest in the middle decades, especially in the fourth, fifth, and sixth decades (see Table 3.9-6c). The same timber production model has been used to calculate growth and harvest for all the alternatives. Consequently, these concerns about the accuracy of the growth and harvest predictions apply to all alternatives, especially those that involve intensive management prescriptions.

Alternative 2a (No Elk River Property)

Alternative 2a is the same as Alternative 2 except that no Elk River Timber Company lands would be exchanged. The Elk River Timber Company lands would continue to be managed for timber.

LTSY volume is similar to Alternative 2. The same concerns about the accuracy of growth and harvest predictions discussed in Alternative 2 apply to this alternative.

Tables 3.9-6e and f show that the proposed harvests in the first two decades exceed growth for those decades. Projected timber harvest in decade one on PALCO's land is 2,214,804 mbfn (Table 3.9-6e). As in Alternative 2, PALCO assumes that once the old-growth, hardwood, and poorly stocked stands planned for harvest in the first two decades are cut and those areas put into intensive management, growth rates would exceed harvest rates. Also as in Alternative 2, PALCO assumes that its intensive management program would continue to be successfully implemented throughout the life of the SYP.

Alternative 3 (Property-wide Selective Harvest)

Only selective harvest would be allowed under Alternative 3. No clearcuts or other even-aged harvesting would be allowed. At least 20 percent of PALCO's lands would be

maintained as late seral forest and the rest would be managed to develop a multi-layer tree canopy with large trees, down wood, and snags. The over 6,000 and 16,000 acres of redwood, Douglas-fir old growth, and residual old growth outside the Reserve would not be harvested, and no salvage would occur. There would be a no-harvest, 600-foot-wide buffer around these stands. No harvest RMZs would be maintained on approximately 14,000 acres. Approximately 123,002 acres would be available for selective timber harvest. The maximum yearly timber harvest would not exceed two percent of the timber inventory. The FREIGHTS model indicates that approximately 18 percent would be cable yarded, and 82 percent would be tractor yarded. However, these high tractor logging percentages are overestimated.

Tables 3.9-6d, g and h show the inventory, growth, and harvest volumes on PALCO lands, including those acquired from Elk River Timber Company. The tables show that growth exceeds harvest in every decade. Harvest only captures less than one-fourth of the growth in every decade. This is significantly below the LTSY for the area projected in Alternative 2 and would result in a significant loss of production.

Projected timber harvest in decade one on PALCO lands is 868,780 mbfn.

The effects on Elk River Timber Company lands transferred into the Reserve would be the same as in Alternative 2. The effects on Elk River Timber Company lands transferred to PALCO ownership would be the same as the effects for other PALCO lands. The result would be a very large reduction of timber production.

Alternative 4 (63,000-acre No-harvest Public Reserve)

Alternative 4 places approximately 63,673 acres into no-harvest reserve. It would comprise approximately 58,996 acres of PALCO land and approximately 4,677 acres of Elk River Timber Company land. The remaining lands would be managed as described in Alternative 2. No-harvest RMZs would be maintained on approximately 2,585 acres outside the Reserve. All timber production would be lost on these areas. Approximately 19,109 acres would have selective harvest to protect riparian function. The remaining approximately 129,144 acres would be available for intensive timber management. Approximately 46 percent would be cable yarded, and 54 percent would be tractor yarded.

Tables 3.9-6i and j summarize the projected volumes of standing timber, growth, and harvest in 10-year increments on PALCO lands. The tables show that growth exceeds harvest in every decade except for the first two decades. The average harvest volume is approximately 70 percent of the LSTY projected for the entire area in Alternative 2. Projected timber harvest in decade one on PALCO lands is 1,650,204 mbfn.

3.9.3 AB 1986 Conditions

Under the HCP, either the Owl Creek or the Grizzly Creek MMCA would be available for harvest. AB 1986 conditions the expenditure of state funds for acquisition of the Headwaters Forest and other lands on the inclusion of several provisions in the final HCP, the IA, and the ITPs intended to strengthen protections for covered species. Should PALCO include those provisions in the final HCP, state monies would be appropriated to the state Wildlife Conservation Board to fund the state's share of the cost of acquiring approximately 7,500 acres of private forest lands, including the Headwaters Forest. Under AB 1986, the Owl Creek MMCA would be protected from harvest for the life of the ITPs, and the Grizzly Creek MMCA would be protected for five years from the date of the adoption of the final HCP. AB 1986 also appropriates additional funding

for the future opportunity to purchase of the Owl Creek. Any funds remaining from those appropriated for the purchase of the Owl Creek MMCA could be used to purchase tracts of the Elk River Property and previously unlogged Douglas-fir forest land within the Mattole River watershed.

The state managing agency and management prescriptions are unknown, and these acquisitions are somewhat speculative. Considering the legislative intent behind AB 1986, it is assumed that purchased lands would be managed similarly to the Headwaters Reserve. These anticipated acquisitions would protect old-growth and residual redwood stands and some Douglas-fir stands within these tracts in perpetuity.

The protection of the Owl Creek MMCA would remove about 925 acres from timber production. The protection of the Grizzly Creek MMCA would remove about 993 acres from timber production. This acreage plus the application of Class I and II RMZ no-harvest prescriptions, as described in Section 3.7.5, would result in less acreage being available for harvest. The combined effect of land acquisition and additional protections on the landscape could reduce

the availability of timber and thus further reduce timber supply in the local area, as well as timber-harvest-related employment.

However, protection and management in perpetuity of any acquired lands would safeguard about 1,213 acres of old-growth and residual redwood and would reduce the risk of loss of rare and uncommon flora associated with commercial timber harvest and commercial timberland management practices.

3.9.4 Cumulative Effects

Cumulative effects on vegetation and timber resources in the redwood region are related to the management direction in the proposed alternatives as well as proposed changes in ownership. PALCO owns nearly 10 percent of the remaining old-growth redwood. How it is managed could have a significant effect on that resource because nearly all the old-growth redwood not protected in parks or reserves is on PALCO lands. Alternative 3 would have the most positive cumulative effect on preserving and developing late-seral and old-growth forest. Alternatives 2 and 2a would preserve the least; Alternative 4 is midway between Alternatives 1 and 3.

Alternative 3 would also protect all old-growth and residual Douglas-fir forest on PALCO lands. Under Alternatives 1, 2, 2a, and 4 old-growth and residual old-growth Douglas-fir would be available for timber harvest. Under Alternative 1, about 52 percent and 62 percent of existing old-growth and residual old-growth Douglas-fir, respectively, would be harvested by year 50. Under Alternatives 2 and 2a, about 59 percent and 80 percent of existing old-growth and residual old-growth Douglas-fir, respectively, would be harvested by year 50. Under Alternative 4, about 57 percent and 82 percent of existing old-growth and residual old-growth Douglas-fir, respectively, would be harvested by year 50.

The alternatives would have an inverse effect on the cumulative timber supply. Commercial timber harvest in Humboldt County has risen and fallen with timber cycles but the general trend is decreasing harvest levels. The 1996 harvest was approximately one-fifth of 1959 harvest. Harvest on federal land has dropped to only about five percent of the 1988 level. PALCO's harvest has assumed an increasingly higher proportion of Humboldt County's harvest as other ownerships' harvest decreased.

The harvest levels associated with Alternatives 2 and 2a represent approximately 45 percent of the total harvest for Humboldt County, based on the 10-year period ending in 1996.

Alternative 4 represents approximately 31 percent, Alternative 1 represents about 27 percent, while Alternative 3 represents only about 10 percent. Stated another way, the county's cumulative timber harvest would be reduced by more than one-third if Alternative 3 is chosen rather than Alternatives 2 or 2a. Since Humboldt County produces nearly one-fourth of the state's harvest, PALCO's harvest also affects the state's production. Alternatives 2 and 2a would have little effect on the state's harvest level; Alternatives 1 and 4 would result in a six percent reduction and Alternative 3 in an eight percent reduction.

3.9.5 Mitigation

3.9.5.1 Mitigation for Rare and Uncommon Flora

Because of the potential for significant effects to rare and uncommon flora under Alternatives 2, 2a, 3, and 4, the following mitigation is proposed. Implementation of this mitigation would reduce effects to less than significant. Presence of rare species should be determined through field inspections incorporated into the field surveys conducted on harvest areas prior to road building and timber harvest. The list of potentially occurring rare species (Table 3.9-4) will have to be updated each year using CDFG NDDB and the CNPS inventory. Soil and forest cover maps should be consulted to identify which species might occur in the proposed THP area and which areas should be surveyed. The RPF's field review can also be used to identify potential habitats that would need surveys. Appropriate field aids, such as color photographs combined with habitat descriptions, commonly associated species, and sketches of diagnostic features, need to be acquired or prepared beforehand.

Areas identified by the RPF as containing potential habitat should be surveyed by a qualified field botanist to demonstrate presence or reasonable absence of rare plants. Credentials of field botanists proposed for the additional plant surveys should be approved by CDFG.

Locations of identified populations of federal or state-listed species, or species on the CNPS Lists 1 or 2, should be reported to CDFG. The locations of yarding and skid trails for the THP should be modified as necessary to avoid identified populations.

3.9.5.2 Mitigation for Natural Vegetation and Commercial Timber

Because the Proposed Action/Proposed Project has no significant effects on natural vegetation commercial timber, no additional mitigation is required. However, PALCO developed the following measures in cooperation with CDF with respect to its commercial timber harvest.

Provisions

1. A schedule of planned treatment for the decade, derived from the harvest schedule, is included in SYP (see Parts B and C of Volume III).

2. Commence on the fifth anniversary of the approval of the SYP, PALCO will submit a report to CDF on the appropriateness of the LTSY level. The report will include verifiable data and other evidence that demonstrates that growth enhancing treatments have been effective in maintaining regenerated stands at appropriate stocking levels and relatively free from overtopping weed vegetation. PALCO will prepare monitoring sampling designs with involvement of CDF and other recognized experts and carry out the appropriate field work and analysis on treatment implementation and stand response.

3. To assure that harvests are not excessive prior to consideration of

any LTSY adjustment, in any one of the first five years prior to the submission of the report from Item #2 above, PALCO will harvest no more than 20 percent above the annual LTSY (subject to adjustment as provided in the SYP for changes in the land base).

4. Annual performance summary reports (see below) will be submitted by PALCO to CDF. If, after two consecutive years of CDF concern that insufficient acres are being treated relative to the schedule then the year five analysis (Item #2 above) may be triggered, at CDF's discretion. CDF will have the ability to visit these locations at any time, after the usual landowner notification. CDF reserves the right to have up to five percent of the sites audited annually by a third party contractor funded by PALCO with responsibility to CDF. Annual implementation reports allow amore timely response to deviations from intensive management assumptions without incurring significant additional cost for either PALCO or CDF. The two-year period recognizes that for any given year circumstances such as weather or catastrophic events may preclude meeting the treatment schedule.

5. CDF concurs that the ultimate yields achieved are best evaluated through the use of periodic inventories of the property. PALCO will address intensive management response at the five-year period and with submission of their next SYP in ten years using contemporary data.

Reporting Annual Monitoring Results

PALCO will provide annual performance summaries to the SYP evaluation program at CDF headquarters. The first performance summary will only cover that portion of the year under which PALCO actually operates under the SYP. Subsequent performance summaries will cover an entire fiscal year from July 1 to June 30. The performance summaries will cover an entire fiscal year from July 1 to June 30. The performance summaries will be due by March 1 of the following year. The data will include, for each year:

1. Acres harvested in that year, by silvicultural prescription
2. Net volume harvested in that year
3. A map of harvest units that were entered for commercial harvest that year, along with, for each harvest unit, the acreage of the harvest unit, and the silvicutlural prescription used
4. A map of harvest units on which planting, site preparation, vegetation control, or precommercial thinning was performed that year, along with, for each harvest unit, the acreage of the harvest unit, and the year of regeneration harvest

In order to initiate the monitoring process, PALCO will provide the data in the Item #4 above to CDF for the fiscal years ending in 1995, 1996, 1997 within two months following the approval of the SYP.

Consequences of Violating the Provisions

A violation of the provisions defined in this document may occur in three ways:

1. A failure to provide CDF with accurate and complete data which demonstrate, in the fifth anniversary report, that the treatments are effective in creating well-stocked stands with trees that are free to grow

2. A failure to substantially comply with the schedule of treatments for two consecutive years

3. A failure to provide annual performance summaries

If it becomes clear that a violation of the agreement has occurred, PALCO and CDF agree that PALCO shall recalculate the LTSY using updated type, property, harvest, inventory data and yield streams that incorporate growth enhancing treatments in proportion to actual achievements. The ten-year harvest level derived from the recalculated LTSY shall apply to the first decade of the SYP.

Table 3.9-6a. Alternative 1 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade[1/]
1	5,449,668	1,776,411	1,712,518
2	5,519,974	1,969,291	1,455,640
3	6,040,969	2,060,757	1,273,685
4	6,823,296	2,115,451	1,146,316
5	7,782,037	2,154,438	1,031,685
6	8,907,006	2,245,756	1,127,145
7	10,031,920	2,203,339	1,239,859
8	10,997,100	2,160,019	1,363,845
9	11,778,450	2,156,422	1,227,461
10	12,710,390	2,093,086	1,298,013
11	13,505,120	2,044,685	1,427,814
12	14,119,050	1,983,455	1,285,032
Average harvest per decade			1,558,901

[1/] Indicated harvest volumes are maximum values. Detailed mapping of Class III stream distribution is poorly known. Class III streams would remove a substantial area from timber harvest, reducing timber volume proportionately.

Source: Vestra Resources

Table 3.9-6b. Alternative 1 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade[1/]
1	5,765,852	1,886,848	1,826,672
2	5,831,391	2,080,613	1,552,671
3	6,366,656	2,181,789	1,358,587
4	7,186,314	2,238,901	1,222,728
5	8,193,011	2,277,859	1,100,455
6	9,371,659	2,370,337	1,199,599
7	10,549,331	2,325,168	1,319,557
8	11,555,501	2,282,520	1,451,514
9	12,372,068	2,275,674	1,306,364
10	13,343,499	2,210,512	1,369,025
11	14,184,208	2,161,072	1,500,447
12	14,842,980	2,103,966	1,350,402
Average harvest per decade			1,379,835

[1/] Indicated harvest volumes are maximum values. Detailed mapping of Class III stream distribution is poorly known. Class III streams would remove a substantial area from timber harvest, reducing timber volume proportionately.

Source: Vestra Resources

Table 3.9-6c. Alternative 2 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	5,004,554	1,774,647	2,335,188
2	4,453,995	1,882,000	1,984,910
3	4,355,315	2,012,830	1,736,796
4	4,632,062	2,168,834	1,563,117
5	5,224,017	2,279,668	1,406,805
6	6,105,130	2,432,650	1,547,485
7	6,991,135	2,438,911	1,702,235
8	7,713,918	2,401,156	1,872,458
9	8,259,261	2,403,115	2,059,703
10	8,596,446	2,336,072	2,265,674
11	8,661,314	2,333,723	2,335,188
12	8,670,639	2,303,732	2,272,910
Average harvest per decade			2,308,247

Source: Vestra Resources

Table 3.9-6d. Alternative 2 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	5,765,776	1,836,051	2,335,188
2	5,276,123	1,958,112	1,984,910
3	5,254,076	2,093,173	1,736,796
4	5,611,453	2,252,225	1,563,117
5	6,286,254	2,365,061	1,406,805
6	7,252,298	2,518,185	1,547,485
7	8,224,242	2,523,319	1,702,235
8	9,030,489	2,482,999	1,872,458
9	9,658,826	2,481,814	2,059,703
10	10,073,819	2,410,998	2,265,674
11	10,212,807	2,404,742	2,335,188
12	10,293,787	2,371,094	2,272,910
Average harvest per decade			1,923,539

Source: Vestra Resources

Table 3.9-6e. Alternative 2a Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	4,753,875	1,687,490	2,214,804
2	4,237,429	1,798,277	1,882,584
3	4,156,761	1,926,177	1,647,261
4	4,433,885	2,070,135	1,482,534
5	5,013,994	2,149,884	1,334,281
6	5,829,290	2,299,189	1,467,709
7	6,668,259	2,308,340	1,614,480
8	7,347,991	2,286,386	1,775,928
9	7,867,960	2,293,287	1,953,521
10	8,207,870	2,224,160	2,148,873
11	8,274,432	2,200,235	2,214,804
12	8,271,474	2,170,072	2,214,804
Average harvest per decade			2,195,158

Source: Vestra Resources

Table 3.9-6f. Alternative 2a Projected Harvest, Growth and Inventory Volumes, All Ownerships

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	5,765,856	1,836,949	2,328,958
2	5,283,437	1,959,057	1,979,615
3	5,266,990	2,099,015	1,732,163
4	5,633,609	2,247,063	1,558,946
5	6,314,119	2,327,885	1,403,051
6	7,237,673	2,477,899	1,540,163
7	8,183,489	2,483,044	1,694,178
8	8,956,442	2,459,429	1,863,597
9	9,563,185	2,460,583	2,032,424
10	9,990,178	2,386,691	2,219,885
11	10,147,178	2,358,742	2,287,437
12	10,231,438	2,329,980	2,280,174
Average harvest per decade			1,910,049

Source: Vestra Resources

Table 3.9-6g. Alternative 3 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	5,005,011	1,945,292	868,780
2	6,080,636	2,336,434	738,463
3	7,677,539	2,429,402	682,237
4	9,427,687	2,438,099	750,460
5	11,102,300	2,412,273	825,506
6	12,693,210	2,367,675	908,057
7	14,159,390	2,275,082	998,863
8	15,435,010	2,199,165	1,028,151
9	16,603,940	2,164,642	1,009,240
10	17,756,270	2,147,402	1,031,919
11	18,854,930	2,114,680	1,135,111
12	19,846,100	2,068,821	1,219,592
Average harvest per decade			1,119,638

Source: Vestra Resources

Table 3.9-6h. Alternative 3 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	5,766,233	2,006,696	868,780
2	6,902,764	2,412,546	738,463
3	8,576,300	2,509,745	682,237
4	10,407,078	2,521,490	750,460
5	12,164,537	2,497,666	825,506
6	13,840,378	2,453,210	908,057
7	15,392,497	2,359,490	998,863
8	16,751,581	2,281,008	1,028,151
9	18,003,505	2,243,341	1,009,240
10	19,233,643	2,222,328	1,031,919
11	20,406,423	2,185,699	1,135,111
12	21,469,248	2,136,183	1,219,592
Average harvest per decade			1,119,638

Source: Vestra Resources

Table 3.9-6i. Alternative 4 Projected Harvest, Growth and Inventory Volumes, PALCO Lands Only

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	3,584,814	1,268,785	1,650,204
2	3,208,559	1,305,344	1,438,906
3	3,080,168	1,409,948	1,259,043
4	3,226,913	1,538,274	1,133,139
5	3,625,893	1,617,536	1,019,824
6	4,227,653	1,694,771	1,121,807
7	4,799,324	1,667,898	1,233,988
8	5,233,991	1,634,934	1,357,386
9	5,508,235	1,631,820	1,401,206
10	5,742,365	1,627,587	1,524,437
11	5,843,837	1,652,671	1,500,185
12	6,000,666	1,627,228	1,650,204
Average harvest per decade			1,629,033

Source: Vestra Resources

Table 3.9-6j. Alternative 4 Projected Harvest, Growth and Inventory Volumes, All Ownerships

Period	Inventory mbfn	Growth mbfn/Decade	Harvest mbfn/Decade
1	4,392,298	1,374,525	1,708,956
2	4,041,185	1,424,967	1,488,846
3	3,955,634	1,540,688	1,302,740
4	4,161,797	1,676,413	1,172,466
5	4,628,606	1,761,035	1,055,218
6	5,307,173	1,843,576	1,160,741
7	5,957,812	1,812,994	1,276,815
8	6,462,627	1,776,713	1,404,496
9	6,801,369	1,769,940	1,453,027
10	7,090,097	1,761,252	1,581,440
11	7,238,534	1,782,123	1,558,937
12	7,437,184	1,753,996	1,708,956
Average harvest per decade			1,687,264

Source: Vestra Resources

Table 3.9-7. Yarding Method on PALCO Lands for the First Decade For Each Alternative (approximate acres)

	Alternative				
Method	**1**	**2**	**2a**	**3**	**4**
Cable	11,258 (29%)	14,399 (26%)	14,329 (27%)	2,499 (20%)	12,198 (46%)
Tractor[1/]	28,176 (71%)	40,482 (74%)	38,669 (73%)	10,167 (80%)	26,716 (54%)

[1/] The FREIGHTS model overestimates the amount of potential tractor logging because slope steepness constraints are not modeled well. It is estimated that about 35 to 40 percent of PALCO's ownership is suitable for tractor logging (D. Opalach, PALCO, Personal communication, September 9, 1998).

Source: Vestra Resources